AUTOMOBILE ENGINEER

DESIGN · PRODUCTION · MATERIALS

Vol. 46 No. 11 NOVEMBER 1956 PRICE: 3s. 6d.

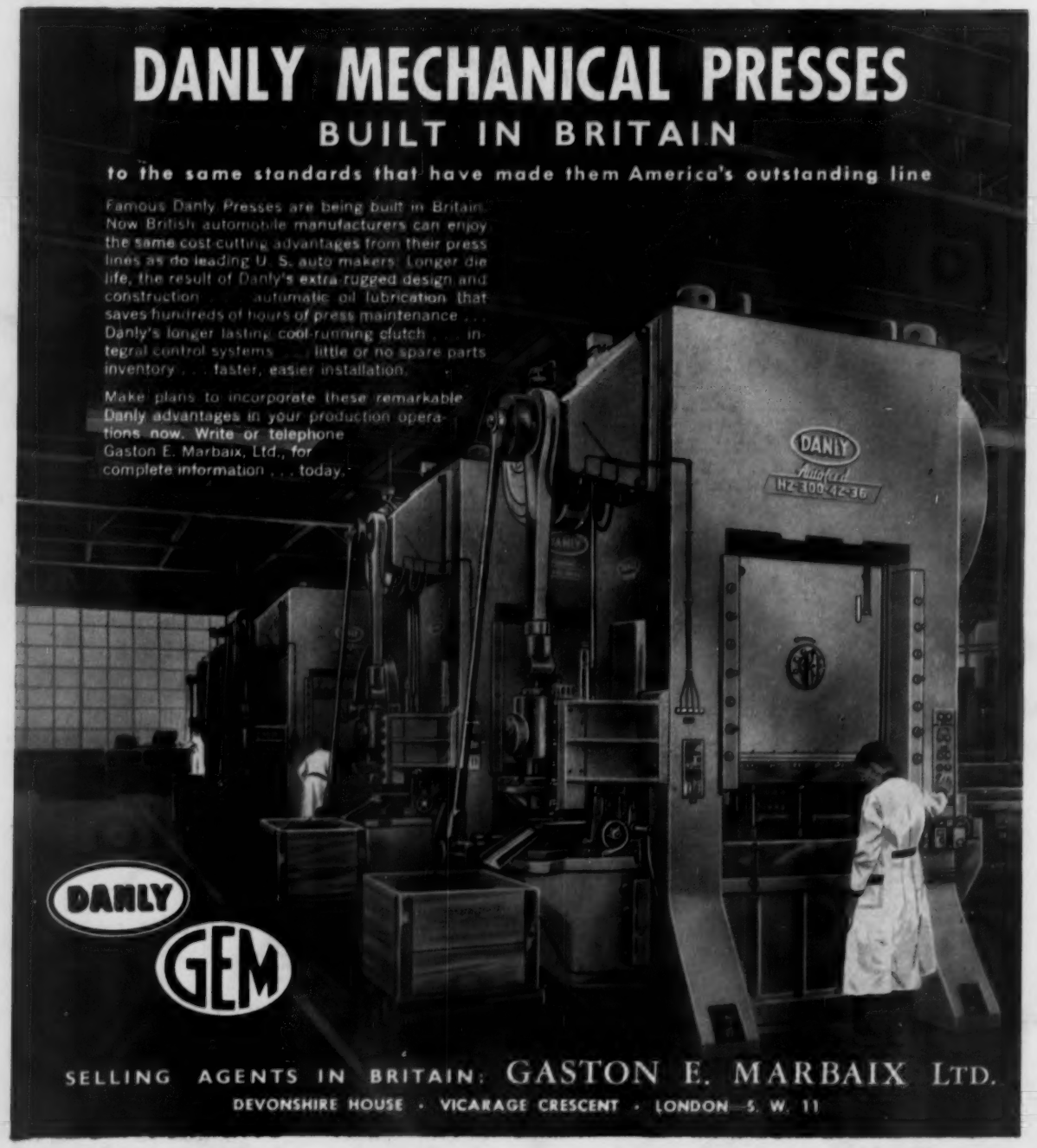
DANLY MECHANICAL PRESSES

BUILT IN BRITAIN

to the same standards that have made them America's outstanding line

Famous Danly Presses are being built in Britain. Now British automobile manufacturers can enjoy the same cost-cutting advantages from their press lines as do leading U. S. auto makers. Longer die life, the result of Danly's extra-rugged design and construction . . . automatic oil lubrication that saves hundreds of hours of press maintenance . . . Danly's longer lasting cool-running clutch . . . integral control systems . . . little or no spare parts inventory . . . faster, easier installation.

Make plans to incorporate these remarkable Danly advantages in your production operations now. Write or telephone Gaston E. Marbaix, Ltd., for complete information . . . today.



DANLY GEM

SELLING AGENTS IN BRITAIN: GASTON E. MARBAIX LTD.

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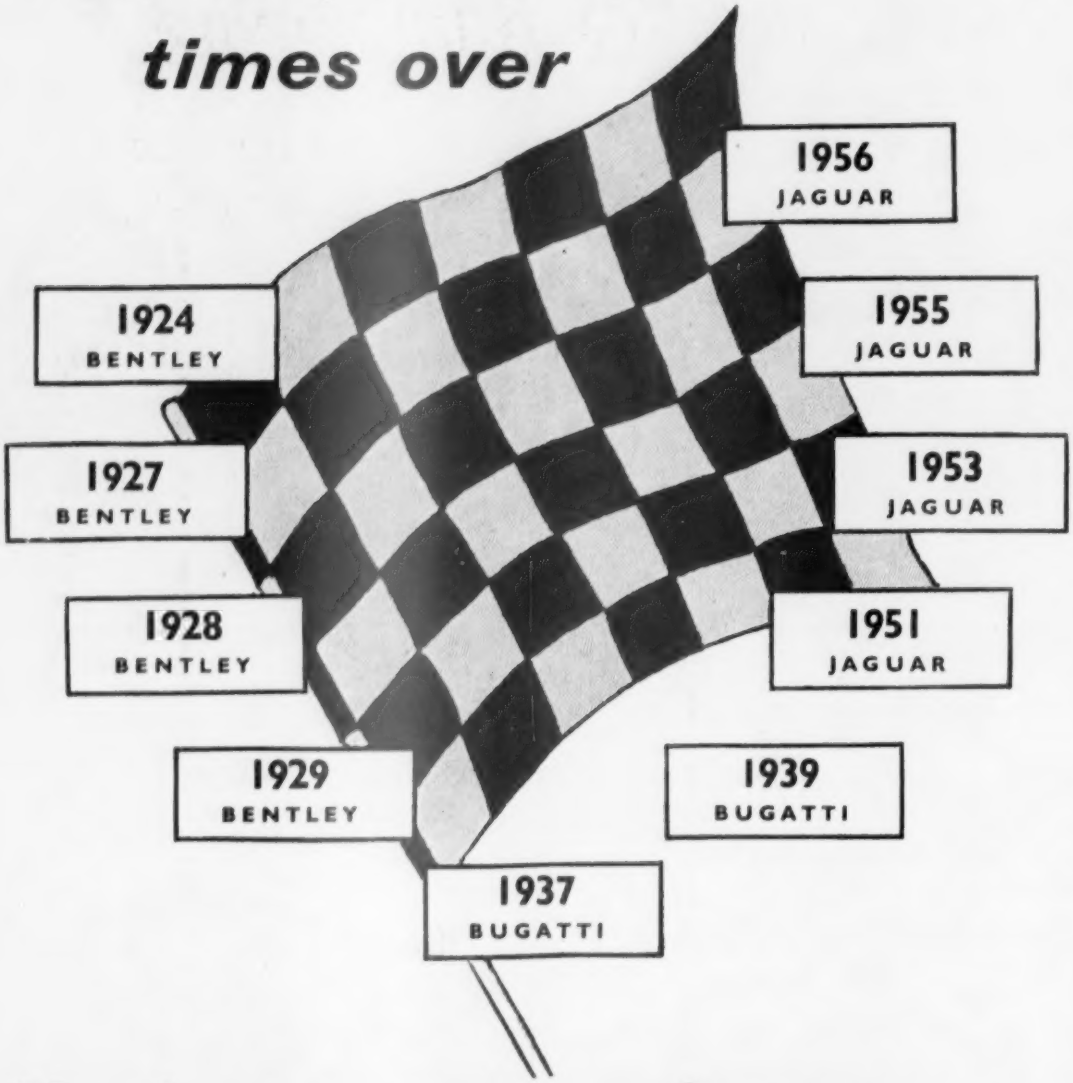
Here's proof ten times over



that you can rely on

There's no stiffer test for a car, or for the life and reliability of its brakes, than the 24-hour road race at Le Mans. This race has been won *ten times* by cars equipped with MINTEX brake liners.

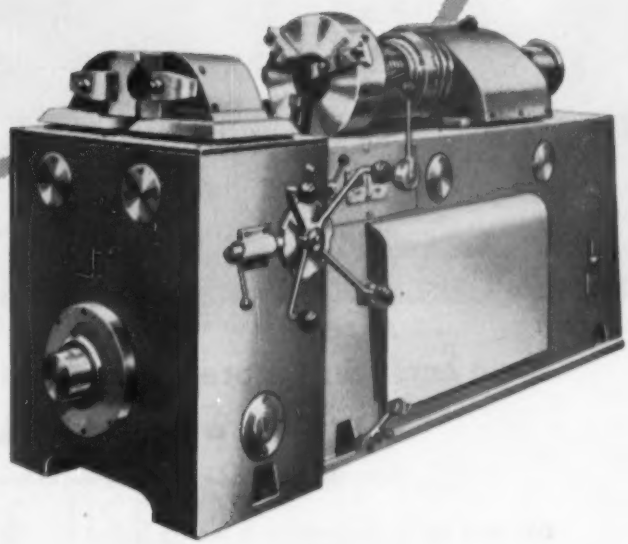
MINTEX

No better liner was ever fitted to a brake shoe

MINTEX brake and clutch liners are manufactured by British Belting and Asbestos Ltd., Cleckheaton, Yorkshire, and are obtainable at leading garages throughout the country.

Cold and Hot Hammering

for faster and better forming at lower cost



The Ribback Hammer is the result of many years' specialist experience in the field of chipless forming and in this latest design the most recent advances in the techniques of cold and hot forming have been adopted.

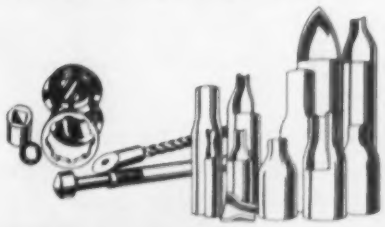
The advantages of the cold forming process are many. It produces clean form and good finish, and because the grain flow is uninterrupted, the fibres follow the contour of the component, thereby increasing the tensile strength and resistance of the material.

Produced in three sizes, these machines are designed for working cold or hot steel and non-ferrous materials at mass-production rates with economy and accuracy.

Cold hammering produces :

Highly polished surfaces
Close tolerance precision
Increased wear resistance
Refined material texture
Increased surface hardness

BRIEF SPECIFICATIONS		Type RD.60	Type RD.125	Type RD.200
Force of blow	tons	40	60	150
Stroke		0·314"	0·314"	0·39"
Adjustment between jaws		1¼"	1⅛"	2"
Blows per minute		720	720	575
Working diameter		⅛"–3"	⅛"–5"	1"–8"
Working height		39"	39"	52"
Feed and return, per minute		17"–35"	17"–35"	17"–35"
Feed length		20"	20"	39"



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Ribback Type Swaging Hammers

For Cold and Hot Forming

WICKMAN LIMITED

FACTORED MACHINE DIVISION, FLETCHAMSTEAD HIGHWAY, COVENTRY

Telephone : Coventry 40351

460F61

'If we can't find more men from inside the aircraft industry—*then we must look elsewhere . . .*'

(Report of a meeting between the Chief Engineer, his Technical Assistant and his Personnel Officer)

C.E. As I see it, the problem is how to attract people by conveying some idea of our future plans without giving away secret information.

P.O. Haven't we first got to convince them that ENGLISH ELECTRIC intend to push ahead with the next generation of aircraft?

C.E. Surely they don't think that after all the work we've done on supersonic flight in general, and the P.1. in particular, we are just going to sit back and go out of business!

P.O. If we can't talk about the aircraft we are planning to build can we say something about the equipment we've got or are going to get?

T.A. For example, is it permissible to point out that our new tunnel has been designed for speeds up to Mach 4, and let people draw their own conclusions?

C.E. There's no reason why we shouldn't. And we can mention the new plant for testing structures and equipment at high temperatures non-stop for hours at a time. In fact we ought to talk about all our test installations.

P.O. Provided we don't thereby give people the impression that we are a great octopus in which the individual is swallowed up.

T.A. I've never yet heard a research man complain about the amount of equipment or the size of the resources at his disposal!

C.E. True, but it's worth pointing out that this Division is a self-contained affair of very reasonable size, with a colossal parent organisation behind it.

P.O. Which of course brings in all the other advantages like security of employment, opportunity for advancement, decent working conditions and help with the accommodation problem.

C.E. And remember we want all grades and sorts —mechanical and hydraulic engineers, heat-transfer experts, metallurgists, physicists, aerodynamics folk—the lot. We must look outside the aviation industry as well as inside. See if you can get something on paper for me.

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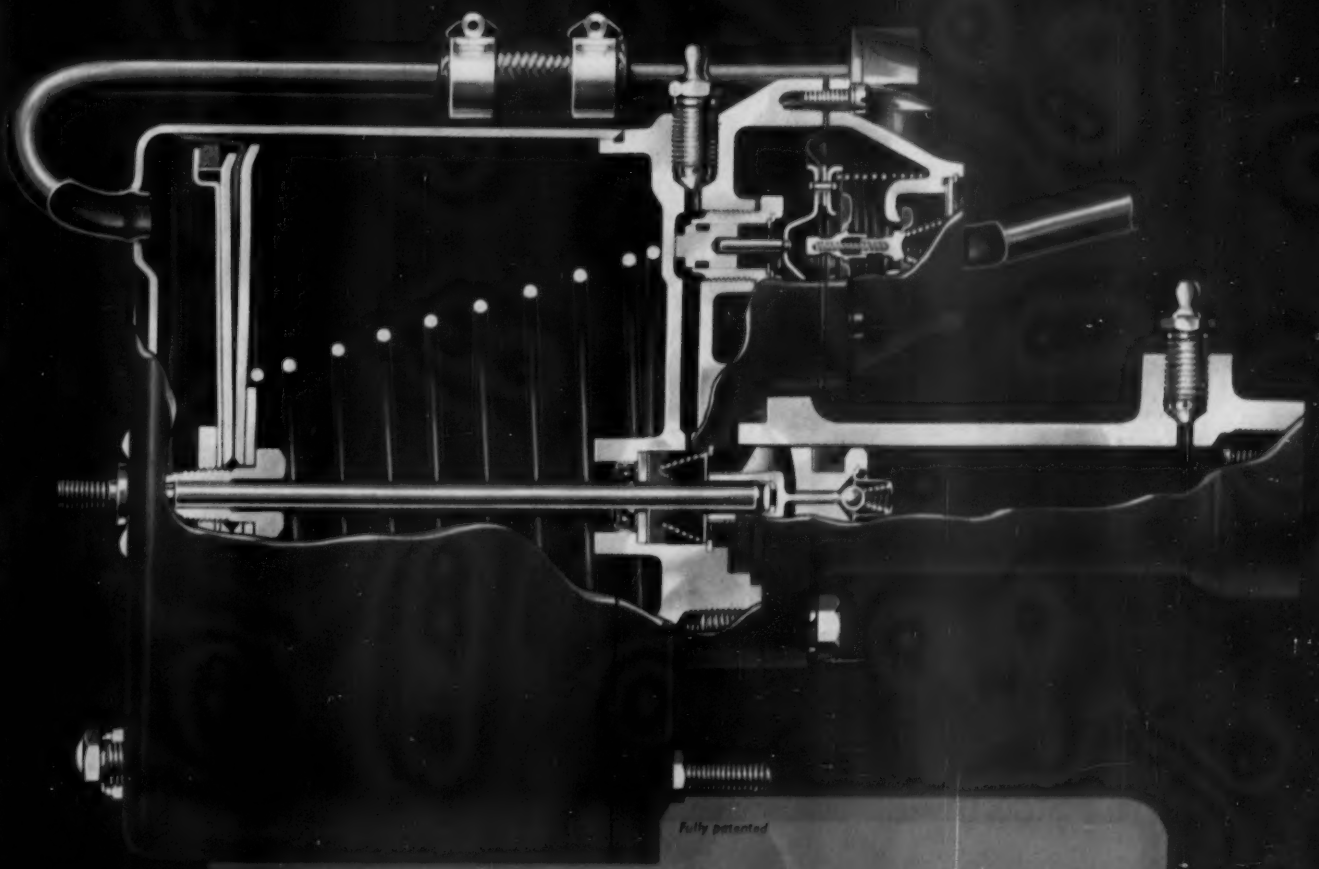

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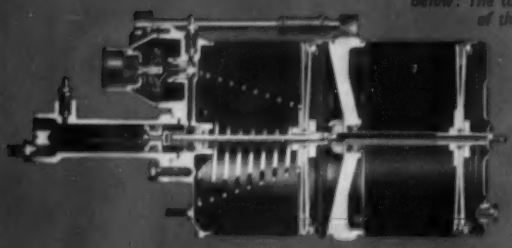
The LOCKHEED *'HYDROVAC'*

The Lockheed 'Hydrovac' is the simplest type of servo brake unit available for petrol-engined vehicles, and it is being used in extremely large numbers.

It combines a vacuum power cylinder and control valve operating a hydraulic master cylinder; the principle of operation is such that many advantages are obtained compared with those of the ordinary vacuum servo. All the working parts are within the unit, and there are no mechanical connections.

Below: The tandem version of the 'Hydrovac'



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COMPANY LIMITED,
LEAMINGTON SPA,
WARWICKSHIRE, ENGLAND

Lockheed, 'Hydrovac' (Regd. Trade Marks)

Lockheed

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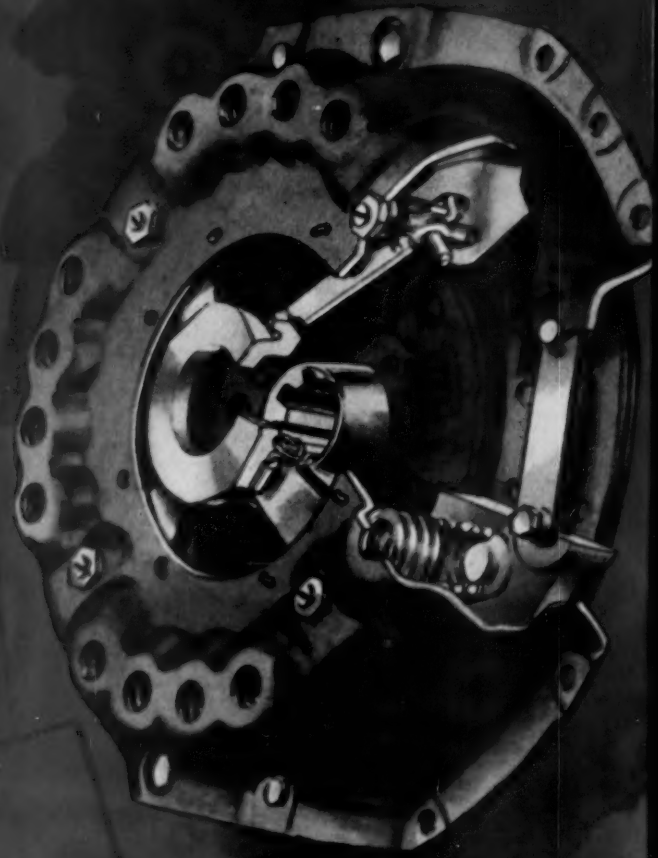

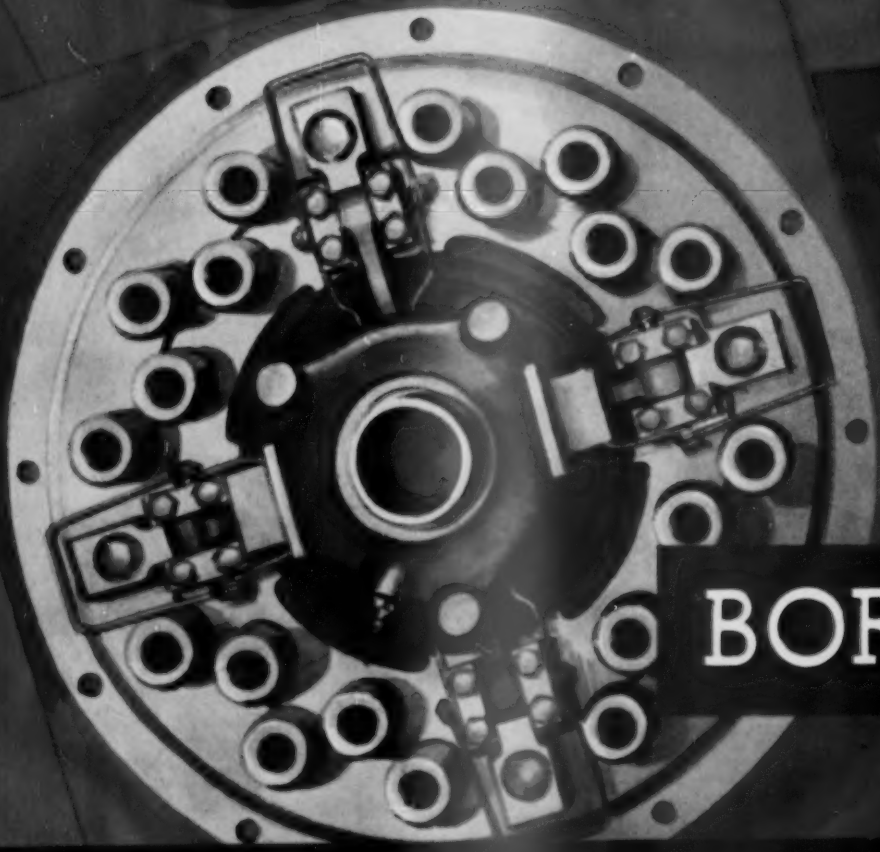

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'A' TYPE.
6½", 7¼", 8", 9", 10" and 11".

STRAP DRIVE TYPE A.S.
12" and 13".

'B' TYPE.
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The torque capacity of these clutches ranges from 38 lb./ft. to 1600 lb./ft.

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10" clutch S.A.E. housing 1, 2, 3 or 4
11½" clutch S.A.E. housing 1, 2, 3 or 4
14" clutch S.A.E. housing 0 or 1.

ROCKFORD

Regd. Trade Marks Borg & Beck

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The friction lining and drive ring

The friction lining—made in segments for ease of replacement—has driving teeth completely round its circumference, and these engage freely with the internal teeth in the driving ring attached to the engine flywheel. In this way the drive is transmitted through surfaces of large area at a large radius, giving a low loading, freedom to float during disengagement, and a long life.

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AND CLUTCHES

The friction members

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The Old Boy coughed and we braked heavily.
"Boy" he said "There seems to be some mistake.
Do you suggest we should chaffer in the
market place like some seller of Oriental Rugs?
Am I to become a Super-Salesman?
Do you imply that we are *in competition*
with some other makers of small tools?
Well — *do* you? Name them, Sir, name them, for
their names will be news to me".
Conceited old fathead.

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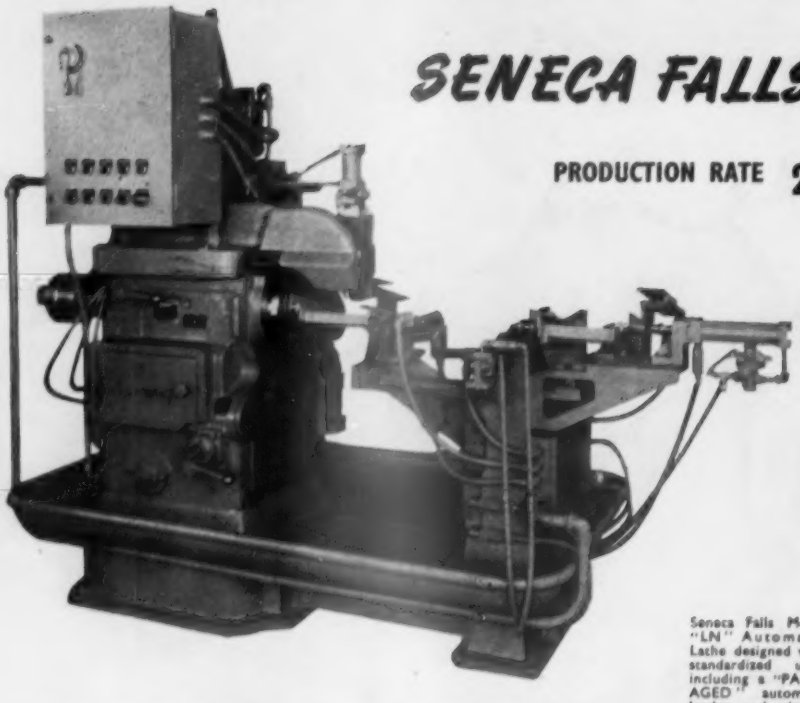
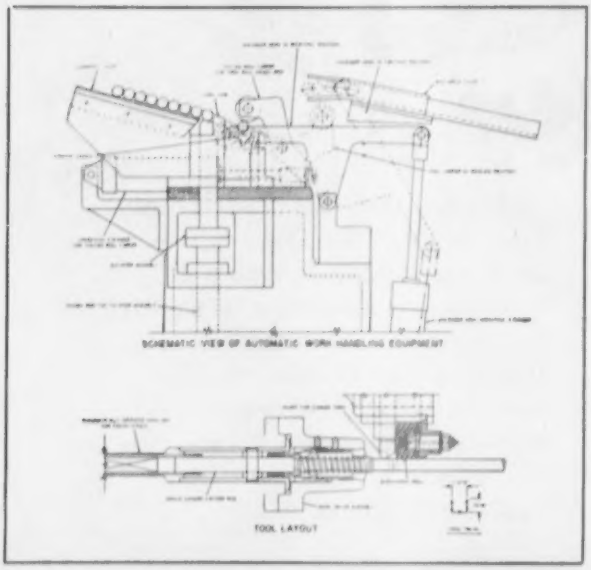
SENECA FALLS "LN" LATHE

PRODUCTION RATE 275 PIECES PER HOUR



Seneca Falls Model "LN" Automatic Lathe designed with standardized units including a "PACKAGED" automatic loader and ejector mechanism



PROBLEM: To remove welding flash from worm shaft assemblies on a high-production basis.

SOLUTION: A Seneca Falls Model "LN" Automatic Lathe was equipped with certain standardized units to provide a specialized high-production machine at substantial savings in initial cost and cycle time.

Red hot welded parts are delivered by a conveyor, which joins the loading chute shown in the line drawing illustrating the automatic work handling equipment. The work piece is held and driven in a collet chuck and supported by a hinged three-roll steady rest. A carbide tool on an overhead slide removes the hot flash and is followed by a burnishing roll which smoothes the junction of the welded parts.

The entire loading, machining and unloading operations are entirely automatic; however, push button controls are installed for the manual operation of each movement. The loading cycle cannot get out of time since the automatic sequence is controlled by a system in which each movement is initiated by the completion of the preceding movement. A production of 275 pieces per hour is readily obtained with this equipment.

FULL DETAILS GLADLY SENT ON REQUEST

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REALLY FAST STOCK REMOVAL
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HOLE BARNESDRIL FINISHING

"PLUGMATIC"

AUTOMATIC SIGNAL LIGHT SIZING
AVAILABLE ON BRITISH BUILT

224A HONING MACHINES

— with

PLAS-T-CLAD *long life deep type stone tooling!*

- HIGH PRODUCTION RATE
- 25in. STROKE UP TO 4in. DIA.
- HYDRAULIC HONE ACTUATION

Patent Nos. 736928—737628—738253—743240 and others applied for

BRITISH BUILT

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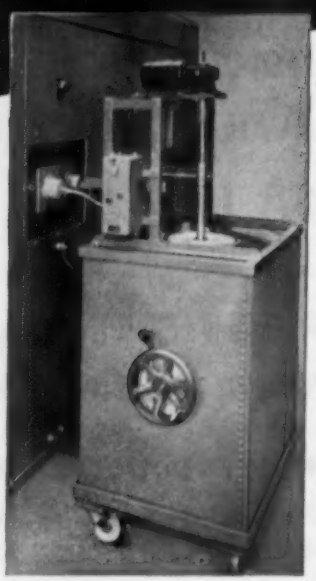

Heating a spur wheel for a tractor gearbox before hardening in the special Redifon quench bath.

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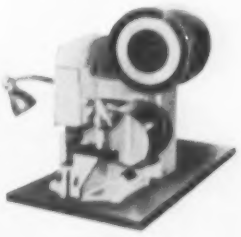

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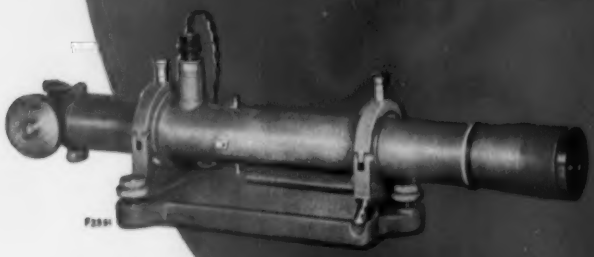

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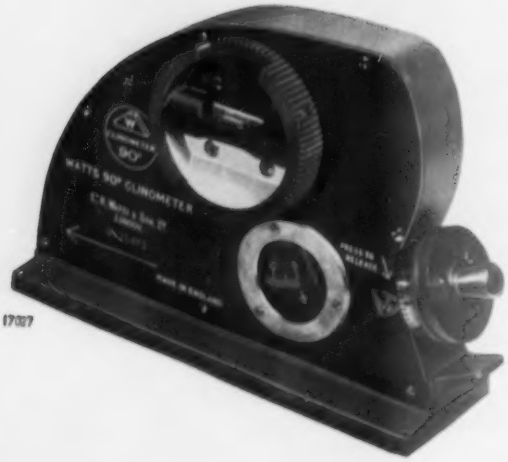

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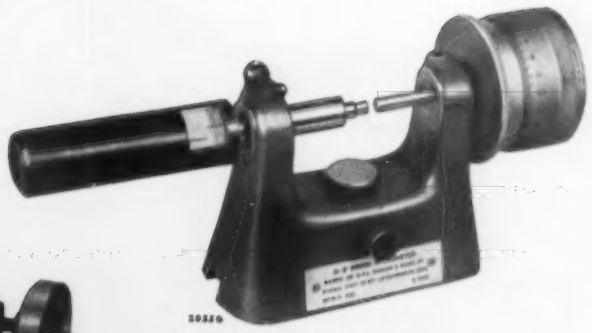
Readings read through a circular aperture adjacent to the micrometer drum. Drum is divided into 60 parts each representing one minute. Drop out worm for quick setting.
Guaranteed accuracy of ±1 minute.



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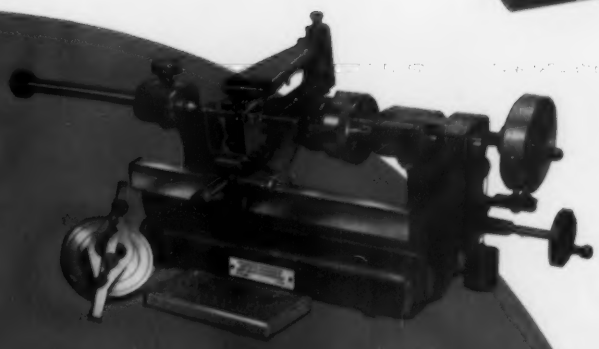
Two sizes of 0"–2" and 0"–4". Micrometer range 1"; measuring pressure 8 ozs. Thimble graduated to ·0001". Fiducial indicator gives magnification of × 200.



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Based on N.P.L. designs: for internal and external pitch measurement of screw threads. Micrometer screw is 40 t.p.i. and the reading scale is 1" wide. Screws up to 9" long can be measured.

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Hand-operated electronic instrument, ideal for surface testing at the machine. Four scale ranges, 0–5 to 25–100 micro-inches enables rough to fine lapped surfaces to be measured.

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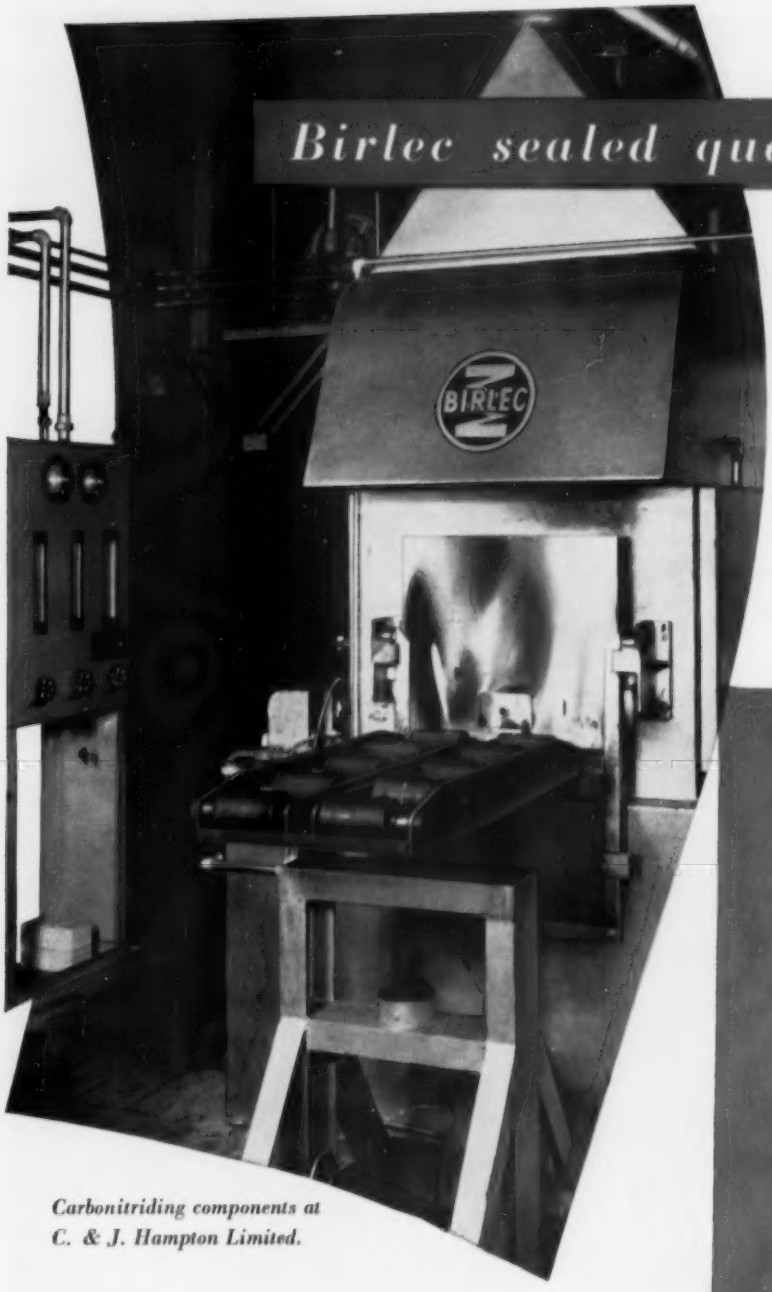

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AUTOMOBILE GEAR DIVISION
PARK WORKS HUDDERSFIELD

SALTER and the Melbourne Olympic Pool

Imposingly designed, in steel and concrete, the top-heavy structure of the Melbourne Olympic Pool, poises on a narrow foundation—SAFELY and SURELY withstanding the full impact of gales and the tremendous moving weight of spectators. Under such severe conditions flexibility is essential, and the Salter Spring Division at West Bromwich provided the answer to the problem.
For each of the 28 vertical straining rods supporting the bowl-like structure providing the seating around the pool itself, giant sets of 24 Belleville Spring Washers were made —restricting the movement to 3" under a load of 25 tons.
Such applications are rare, but spring problems, however large or small, are our prime interest—our Design Department is always at your service.

THE MELBOURNE OLYMPIC POOL

SALTER SPRINGS FOR SWIMMING POOLS *(and many other purposes too!)*

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The new home of *Angus* Fluid Sealing Products

We have now moved to this new factory where we have provided the most modern and efficient production plant, office accommodation and increased research facilities. We feel sure this move will result in even better service to our many friends and customers. Do not hesitate to consult us over your sealing problems.

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ESTABLISHED 1788

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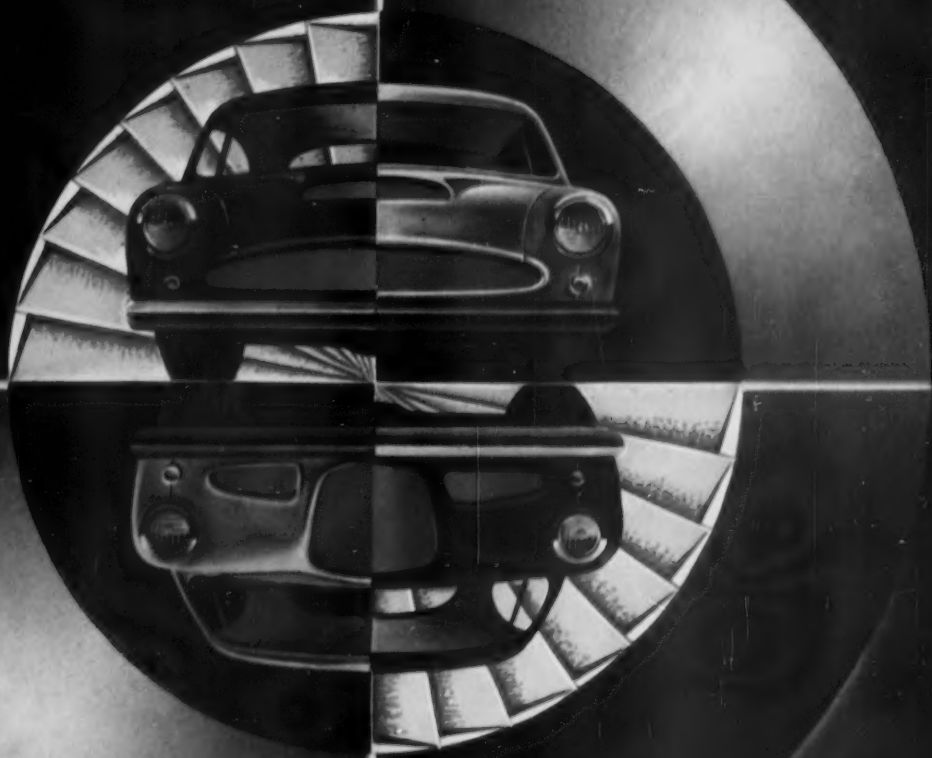
OIL SEAL DIVISION
COAST ROAD, WALLSEND-ON-TYNE
Telephone : Wallsend 64511. Telegrams : Gaco Wallsend.

At the windtunnel stage...



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Cogent

MOLYBDENUM'S PLACE IN INDUSTRY

CASE-HARDENING STEELS ....
PART OF THE NATIONAL ECONOMY

In a great many industries the whole programme of modernization, expansion, mass production and export is dependent on products embodying case-hardening steels.

More than half-a-million tons of steel alloyed with Molybdenum are produced in Great Britain per annum; much of this is case-hardening steel. The importance of the many factors involved in obtaining consistent quality in the finished case-hardened part, throughout a high-production programme, has led to a great increase in the use of Molybdenum-bearing case-hardening steels.

The reason is that Molybdenum makes it easier to ensure the following combination of advantages:

CLOSE CONTROL OF CASE CHARACTERISTICS;
WIDE RANGE OF CORE STRENGTH; GOOD MACHINABILITY;
UNIFORM RESPONSE TO HEAT TREATMENT; LOW DISTORTION;
GOOD WEAR RESISTANCE

HELP MASS PRODUCTION WITH

MOLY

'PRONOUNCED MOLLY'

CLIMAX MOLYBDENUM COMPANY OF EUROPE LIMITED, 99 PINSTONE STREET, SHEFFIELD, 1

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Laycock DE NORMANVILLE Overdrive

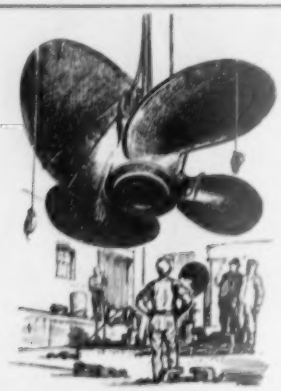
including . . . AUSTIN-HEALEY *100 Six*

Yet another of Britain's finer cars is added to the long list of makes whose specifications carry the hall-mark "LAYCOCK de Normanville OVERDRIVE". This is further proof of the increasing appreciation by manufacturers and public alike of the *exclusive* advantages of this ALL-BRITISH unit. Apart from petrol-saving and reduced engine wear the LAYCOCK Overdrive offers complete driver control; fully power-sustained changes, and positive engine-braking at all times.

LAYCOCK ENGINEERING LIMITED SHEFFIELD

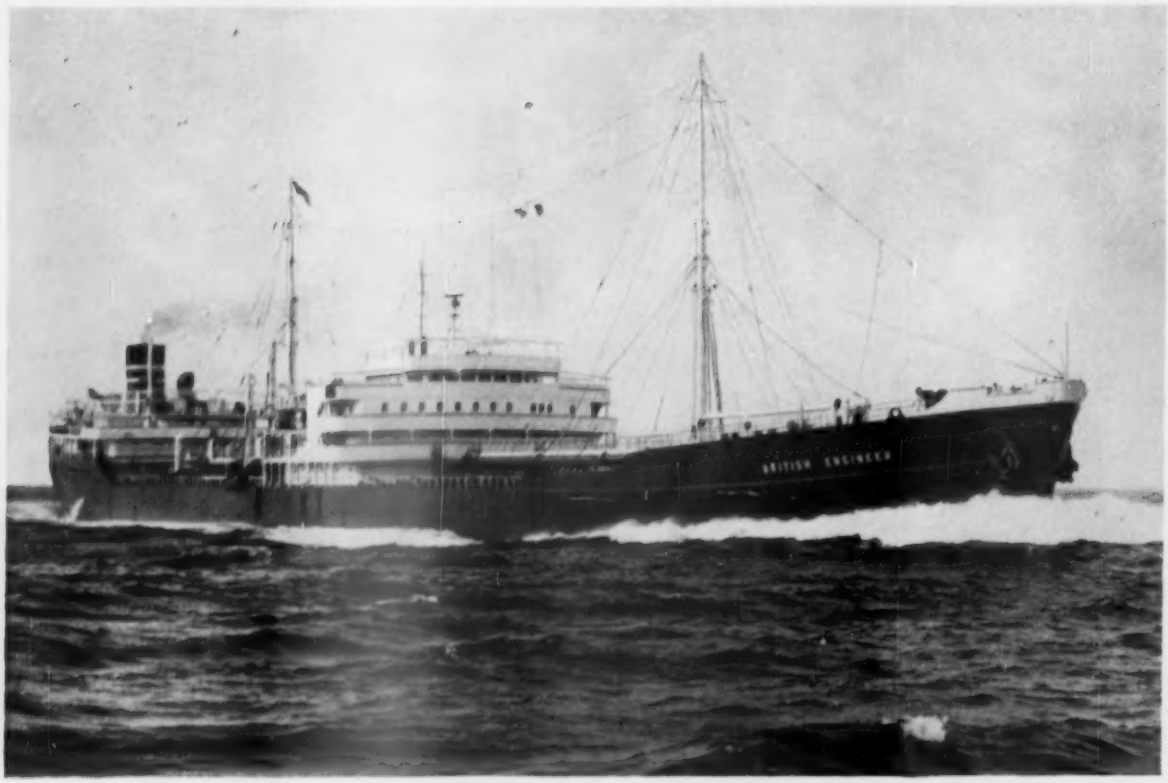
Enquiries to: Laycock Engineering Limited, Overdrive and Transmission Sales Division, 16/17 Hertford Street, Coventry. Under exclusive licence from Auto Transmissions Ltd., Coventry. Electrical controls by Joseph Lucas (Electrical) Ltd.

COPPER



makes a good job better

Over a thousand tons of copper may be used in a large ocean-going vessel. Propellers, condenser tubes and distillation plant are almost invariably made of copper alloys to resist salt-water corrosion. Miles of copper tube and wire are used in the plumbing and electrical installations, while copper alloy tubes are often used for heating the oil in tankers. Large quantities of brass and gun-metal are used for port-holes, doors, voice-pipes and countless other deck and cabin fittings. The hull is protected from marine organisms by anti-fouling paints containing copper.



Not only in shipbuilding, but in most major industries, copper and its alloys play a vital part. The purpose of the Copper Development Association—a non-trading organisation—is to advise on the best uses of copper and its alloys. Its services are always available without charge or obligation.

COPPER DEVELOPMENT ASSOCIATION

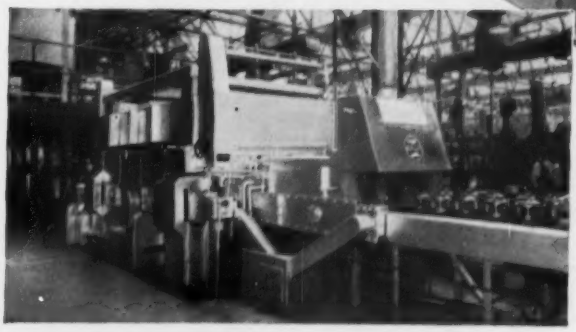
KENDALS HALL · RADLETT · HERTS · RADLETT 5616

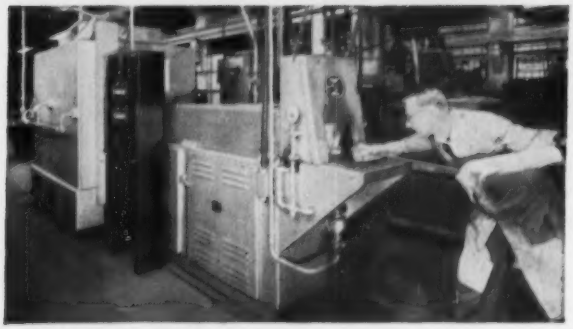
TCA 617

ASSEMBLING — the facts

Left: Mesh belt furnace for all small components

Below: Roller hearth conveyor for high production of heavier parts





Above: Semi batch pusher furnace for varied types of work

Copper brazing, the bonding of mild steel components into a complete assembly, eliminates uneconomical fabrication methods such as machining from solid stock, welding, riveting, torch brazing, soft soldering and forging. Throughout industry, specially designed Birlec copper brazing furnaces of the mesh belt, pusher, and roller hearth types are effecting considerable saving in time, space, and labour and tool costs.

BIRLEC LIMITED

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All sizes . . .

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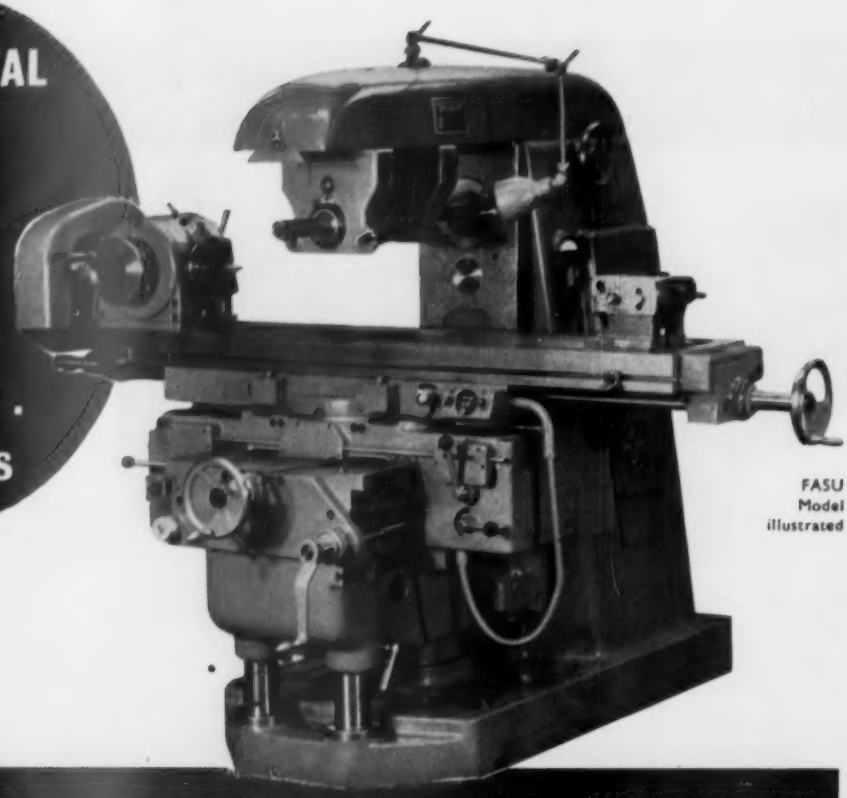

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Model
illustrated

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Early delivery of all models from London stock

SOLE AGENT

Selson
MACHINE TOOLS

BRIEF SPECIFICATIONS				
FOUR SIZES	No. 2	No. 3	No. 4	No. 5
Working surface of table (approx.)	40" x 8"	50" x 10"	64" x 12"	80" x 16"
Power longitudinal travel (approx.)	25"	32"	40"	50"
Power cross travel (approx.)	8"	9"	12"	16"
Spindle Speeds	63-2500	45-2000	32-1400	18-1400

The Selson Machine Tool Co. Ltd

CUNARD WORKS, CHASE ROAD, NORTH ACTON, LONDON, N.W.10

Telephone: Elgar 4000 (10 lines) Telegrams: Selsomachi, London

THE 600 GROUP

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PERFOR

PRODUCT OF EXPERIENCE IN DESIGN AND

Metalastik have always led the way in rubber-bonded components because they have steadfastly combined research, inventiveness, skilled design and perfected methods of manufacture.

This section of automobile engineering, involving a clear insight into many often-conflicting factors and the capacity to find a successful solution to a problem, is probably less widely understood than any other branch, and unless in the forefront of progress a manufacturer is liable either to 'come unstuck' or to remain content with being a Chinese copyist—with the accompanying pitfalls.

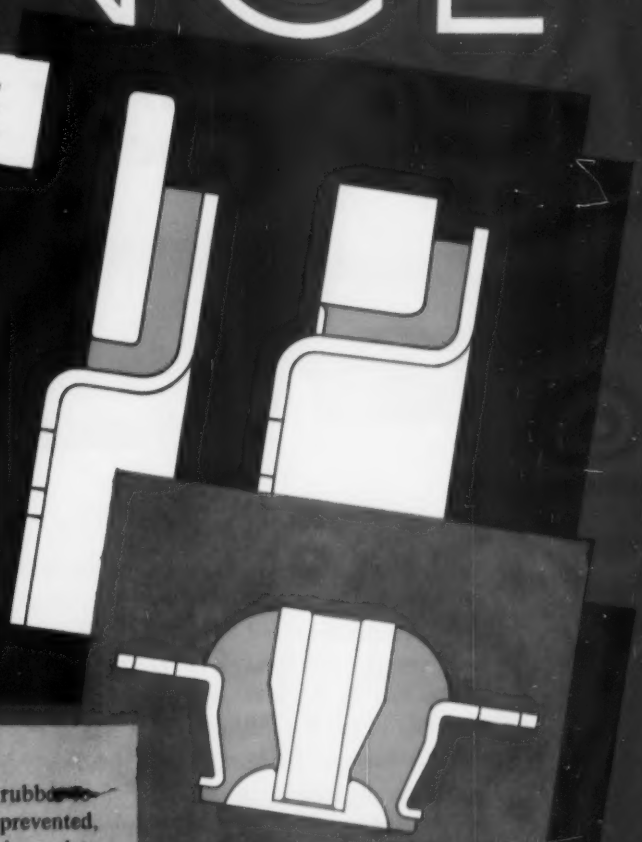
Here are some components which are typical results of Metalastik leadership:

MANCE

MANUFACTURE

TORSIONAL VIBRATION DAMPERS

There is probably no component in the world which is so simple and yet so efficient in performing an important duty as the Metalastik torsional vibration damper. Its advantages are well-known, and they have been reached only by the unsurpassed skill of Metalastik in analysing the requirements of each engine, and then designing and manufacturing dampers to suit it.



METACONE MOUNTINGS

Here is another example of Metalastik success. With the rubber-to-metal weld to both the inner and outer sleeves, creep is prevented, and the formation of the sleeves is such that the rubber is used to the best advantage in compression as well as in shear.

There are many designs available covering a wide range of load/deflection characteristics.

HIGH-DUTY AND ULTRA-DUTY SHACKLE PINS

The high-duty shackle pin (shown alongside) was first evolved at the request of Leyland Motors Ltd., and has many millions of miles of service behind it on heavy vehicles—many bushes being replaced for further service after 400,000 miles.

The Ultra-Duty bush below is its younger brother for use on lighter buses and goods vehicles.

METALASTIK

LEADERS IN THE BATTLE AGAINST VIBRATION

METALASTIK LTD., LEICESTER

A new line of CP air tools

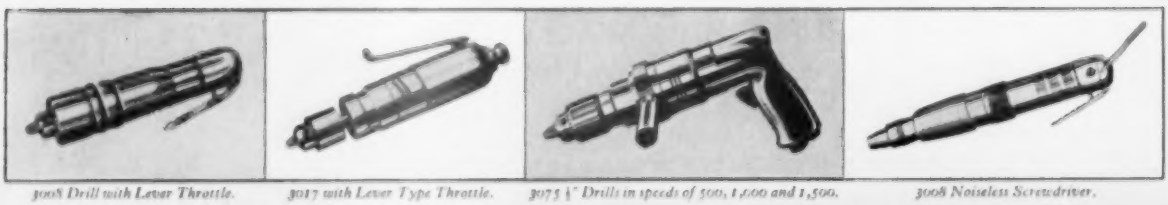
– MORE POWERFUL
– MORE COMPACT
– MORE PRODUCTIVE

MODEL 3017—¼" DRILL

This new CP range of air tools is of interest to every production man looking for machines having compactness and ease of handling, yet also possessing ample margins of power.

The line of drills ranges from $\frac{3}{16}$" to $\frac{1}{2}$" capacities in many speeds and a choice of lever or offset handles. The Screwdriver is the new supersonic machine in which noise is overcome by raising the exhaust above audio frequency.

All these tools are worthy of attention because of their high performance and complete reliability so important for production line work. Ask for descriptive literature.



3008 Drill with Lever Throttle. *3017 with Lever Type Throttle.* *3075 ¼" Drills in speeds of 500, 1,000 and 1,500.* *3008 Noiseless Screwdriver.*

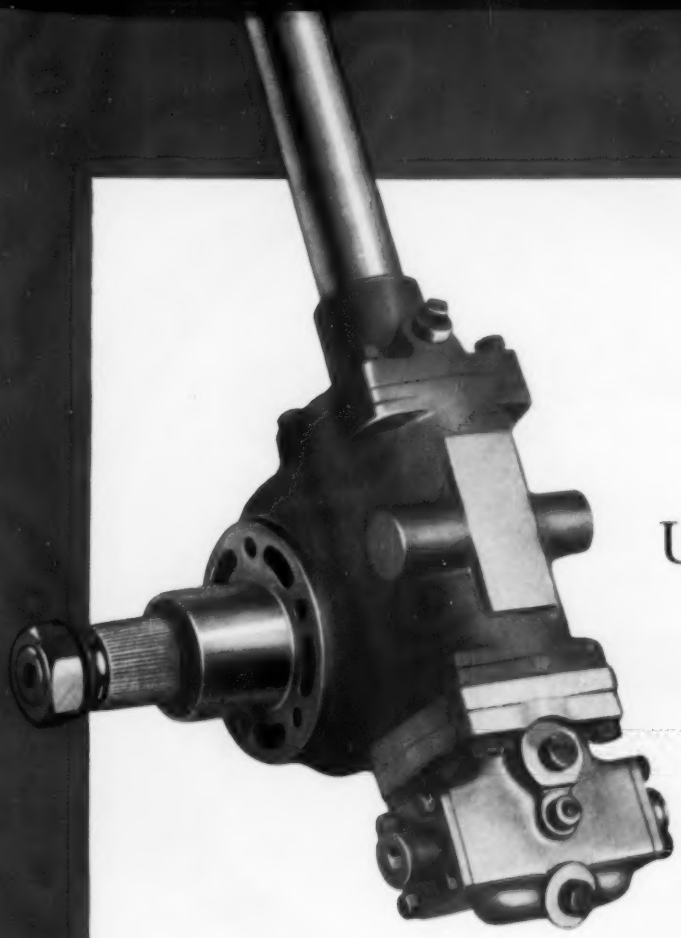
3008 Drills ⅜ —½" in speeds of 3,000 and 5,000 r.p.m.

Consolidated Pneumatic

MAKERS OF HIGH-CLASS ROCK DRILLS, AIR COMPRESSORS AND POWER TOOLS

CP101

CONSOLIDATED PNEUMATIC TOOL CO. LTD. · 232, DAWES ROAD, LONDON, S.W.6.



THE UNIVERSAL UNIT

In a previous advertisement we showed the Marles patent 'Integral' type power assisted steering unit, in which a cam and double-roller steering gear, the valves, cylinders and pistons are included. We now illustrate above the 'Universal' steering gear which incorporates the hydraulic control valves mounted upon our type '861' manual gear. This is for use with a separate power pump and with power cylinders operating on the steering linkage.

ADAMANT ENGINEERING CO. LTD., DALLOW ROAD, LUTON

Sole proprietors of the Marles Steering Company Ltd.

Telephone : Luton 2662 (4 lines) Telegrams : Adamant, Phone, Luton

MARLES

The position of leadership entails responsibility, and the Ferodo organisation is forever experimenting, improving and developing so that they may rightly claim FERODO WILL ALWAYS BE FIRST.

Ferodo Limited · Chapel-en-le-Frith

A Member of the Turner & Newall Organisation

FERODO

Ferodo will always be first

Ferodo Limited are the largest manufacturers of brake linings in the British Commonwealth. They have, over the years, been the first to develop and introduce such *major improvements in brake lining technique as asbestos based materials, die pressing, moulded materials, and non-wire woven materials.* The Ferodo Laboratories and Test House, unique in scope and application, are constantly engaged in testing and developing new materials and methods, keeping always a step ahead of higher speeds and mechanical developments.

Ferodo Linings are fitted as first equipment to more makes of vehicles than all other Brake Linings combined

The choice of Ferodo by this majority of Automobile Manufacturers emphasises the confidence placed in them, after the most stringent tests, by the motor industry.

rake linings · clutch facings · fanbelts

devotion to dampers

The Universal Dampers Organisation is the only concern in the United Kingdom devoted entirely to the production of the damper. The results of this concentration of energies are Rotoflo and Telaflo; no other dampers in the world have an equivalent background of single-minded development. No other dampers in the world have achieved the same standard of technical efficiency.

ROTOFLO ROTARY TYPE non-friction dampers operating on the unique Pressure Flow principle, exceptionally reliable, virtually attention free, low in initial cost and *adjustable*.

TELAFLO the current peak in telescopic damper design: tough and untemperamental, built to tackle the roughest going and to give the smoothest ride. Available in variations of end-fitting and setting for almost every vehicle using direct-acting dampers.

TELAFLO ADJUSTABLE Dampers chosen to provide instant ride-control at all speeds and under all conditions from the driver's seat of the special equipment Armstrong Siddeley Sapphire 346. The first dampers of their kind to go into normal production. Shortly to be available for other makes of car.

Original products of the

UNIVERSAL DAMPERS ORGANISATION

SHIRLEY, BIRMINGHAM

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for everything in power transmission

Clutches—455

Conveyor Pulleys—853

Couplings—356

Double Helicals—535

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Machine-cut Gears—5519

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Quote appropriate publication number as above, when writing for literature.

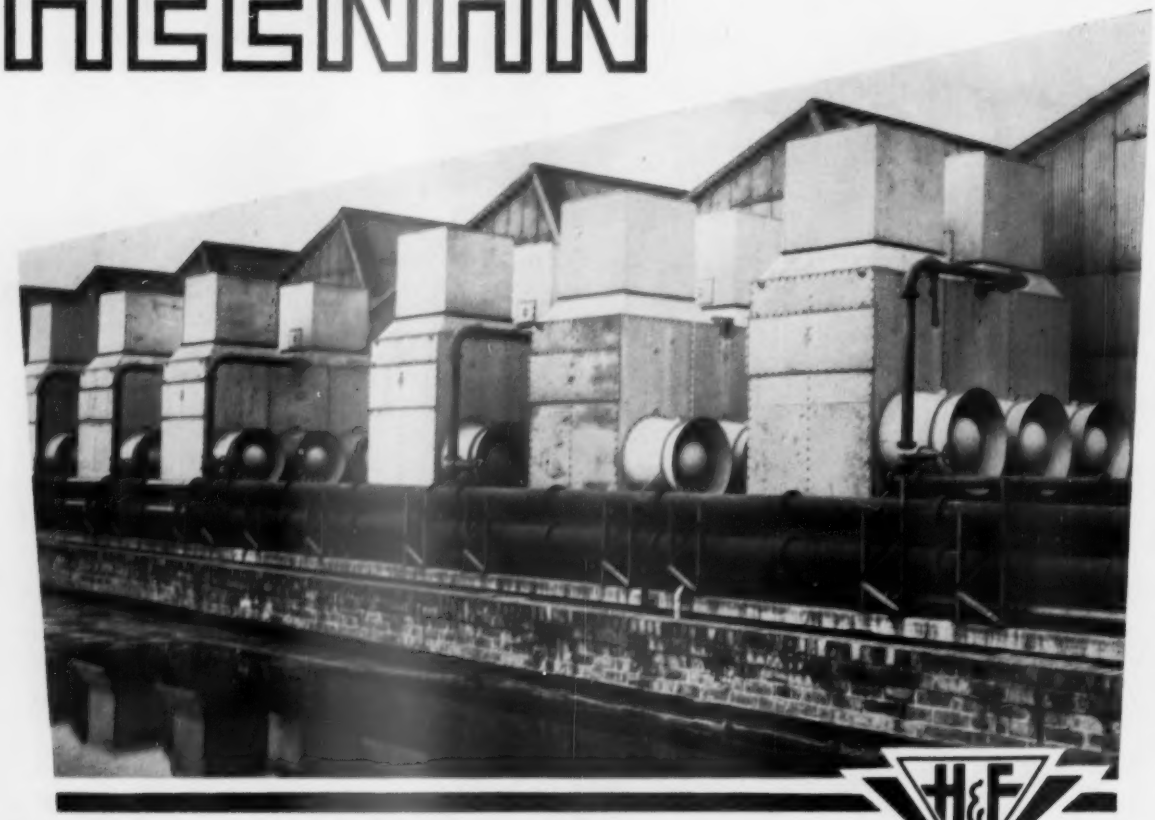
CROFTS (ENGINEERS) LIMITED BRADFORD 3

POWER TRANSMISSION ENGINEERS

Tel.: 65251 (20 lines) Grams: 'Crofters Bradford Telex' Telex 51-426

Branches at: Belfast, Birmingham, Bristol, Cardiff, Dublin, Glasgow, Leeds, Liverpool, London, Manchester, Newcastle, Northampton, Nottingham, Sheffield, Stoke

HEENAN



WATER COOLERS

A battery of six Heenan Water Coolers installed by the Metropolitan-Vickers Electrical Co. Ltd. at their Mosley Road Works, Manchester.

Heenan Water Coolers and Heenan-Marley Aquatowers, by reducing water costs, quickly pay for themselves. Users of diesel, gas and petrol engines, refrigerating plant, air compressors, liquid controllers, or other machinery needing constant supplies of cool water, can reap a handsome dividend year after year by their installation.

HEENAN & FROUDE LIMITED · WORCESTER · ENGLAND

PROVED IN SERVICE

Smallest in the DAVID BROWN range, the 430C 4-speed Gearbox has proved itself as a completely dependable unit designed for light commercial vehicles up to 25 cwt. capacity.

Outstanding features include quietness and ease of operation, simplicity, sturdiness, low weight to strength ratio and exceptionally short overall length. Here is a compact unit that will fit simply into chassis layouts within its range.

Specification E393.22, giving complete details, is available on request.

STANDARD GEARBOX RANGE

	Type	Max. Engine Torque (lb/ft)	No. of Speeds
	430C	90	4
	437	133	4
*	542	205	5
*	45	250	5
*	045	250	5
†	S450	300	4
*	557CM	350	5

2-speed epicyclic unit—either overdrive or underdrive, suitable for 350 lb. ft. maximum engine torque.

* *These units are available with either an overdrive or direct top gear.*

† *Synchromesh for all speeds.*

THE
DAVID BROWN
CORPORATION (SALES) LIMITED
AUTOMOBILE GEARBOX DIVISION
PARK WORKS HUDDERSFIELD

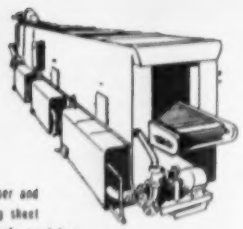
EFCO

Di-PHASE PARTS WASHING MACHINE *for the* AUTOMOBILE INDUSTRY

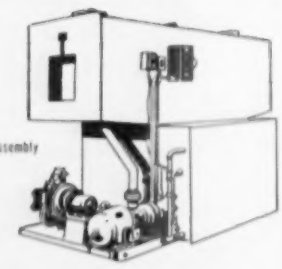
High production metal cleaning by EFCO DI-PHASE is cheaper, more efficient and non-toxic.

The above illustration is of a recent washing installation for the automobile industry, where uninterrupted production is most essential. Efficient parts-washing is absolutely necessary in Motor Vehicle construction where the assembled units must "Work First Time"

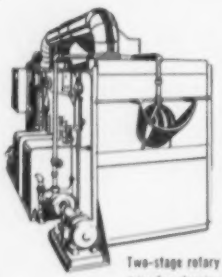
Fifteen years of experience of Di-Phase cleaning are at your disposal.



Three-stage washer and drier for cleaning sheet metal stampings before painting



Single-stage washer for cleaning refrigerator compressor bodies prior to assembly



Two-stage rotary drum washer with drier for cleaning automobile rocker arms and rocker arm balls

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DEMONSTRATION

Let us show you savings – up to 50 per cent of trichlorethylene.

A demonstration unit is available at our Woking Laboratory

May we fix an appointment?

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ELECTRO-CHEMICAL ENGINEERING CO. LTD.

FORSYTH ROAD, SHEERWATER TRADING ESTATE, WOKING, SURREY · TELEPHONE WOKING 6400

Associated with Efco Ltd., Electric Furnace Co. Ltd., Electric Resistance Furnace Co. Ltd.

Coles for that extra margin-

-of control and safety

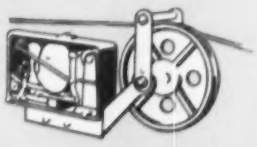
Coles fatigue-free day long operation, pin-point accuracy and fast automatically safe motions, perform an unrivalled role in the automobile industry

Essential for double-tier loading, Coles high angle cantilever jib and *Electric Transmission* system provide that extra margin of lift and safety with an instant choice of rapid or slow precise creeping speeds for lifting, derricking and slewing.

Always on hand to solve the numerous lifting problems that crop up in any factory, Coles have many saving ways.

ELECTRIC TRANSMISSION

Coles have cleared the decks - no inaccessible spots here. Individually powered electric motors provide smooth sustained power for all motions.



SAFE LOAD INDICATOR

Warns visually and audibly when maximum load is reached in any jib position, and positively cuts the motion if the warning is ignored

COLES

THE NAME THAT CARRIES WEIGHT

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226

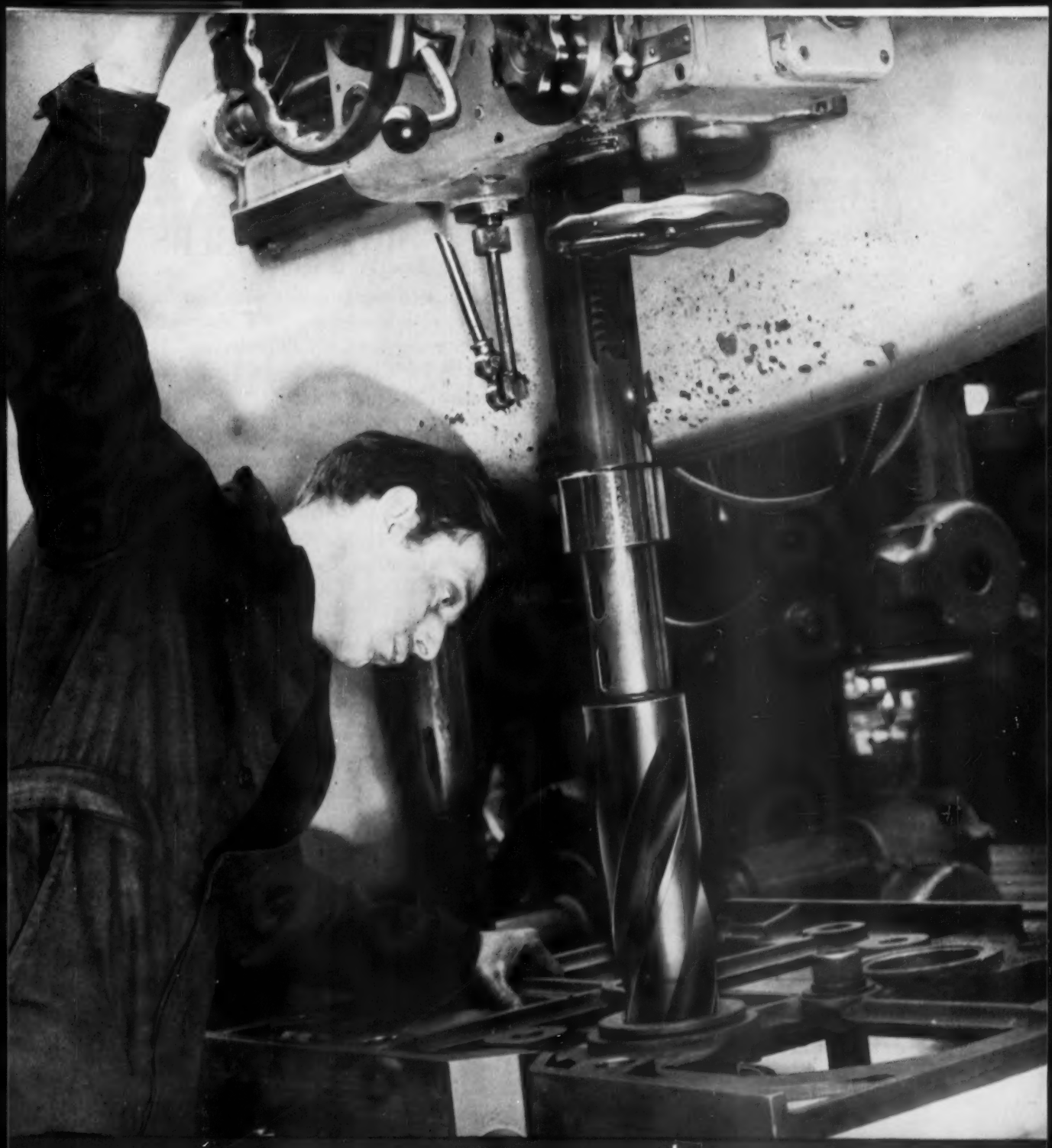
assembly lubricants that "stay put"

On motor-car engines—and other mechanical equipment—oil films tend to run from bearing surfaces during the period of immobility between assembly and running-in. A **'dag'** dispersion of colloidal graphite applied initially provides all bearing surfaces with a protective graphite film which will "stay put" during the critical starting-up and running-in stages.

Illustration shows ***'dag'*** *colloidal graphite being applied during engine-assembly at the works of the Standard Motor Co. Ltd., Coventry.*

dag
REG. TRADE MARK
DISPERSIONS
colloidal graphite

ACHESON COLLOIDS LTD
18 Pall Mall, London, S.W.1 *Tel:* Whitehall 2034-9 · *Grams:* Oildag, Piccy, London



I use **DORMER** tools
for what I get out of them...

Improved performance
Improved output
Improved income

THAT'S WHY DORMER
MEANS TOP RATE TO ME

THE SHEFFIELD TWIST DRILL AND STEEL COMPANY LIMITED
SHEFFIELD ENGLAND

DORMER TOOLS ARE OBTAINABLE FROM YOUR USUAL STOCKHOLDING MERCHANTS

ALL-AIR RANGE SHIFT CONTROL ON LATEST ROADRANGERS

Multi-speed transmissions with two operating levers have always proved a headache to the drivers owing to the difficulty and delays of making some of the changes.

In their ROADRANGER series, Fuller have completely solved this by providing single lever control, the shifts in the two-speed box in tandem with the main box being air operated. All range shifting, up or down, is actuated by a selector handle, at the driver's fingertips, on the gear shift lever. Range shifts are pre-selected, automatic and synchronised.

Fuller heavy-duty ROADRANGER boxes are now available in three types, the R-46 (as illustrated) for engines of 460 cu. in. provides 8 forward speeds; the R-96/R-960 series for engines of 960 cu. in. provides 10 forward speeds; the R-1150 for engines of 1150 cu. in. provides 9 forward speeds.

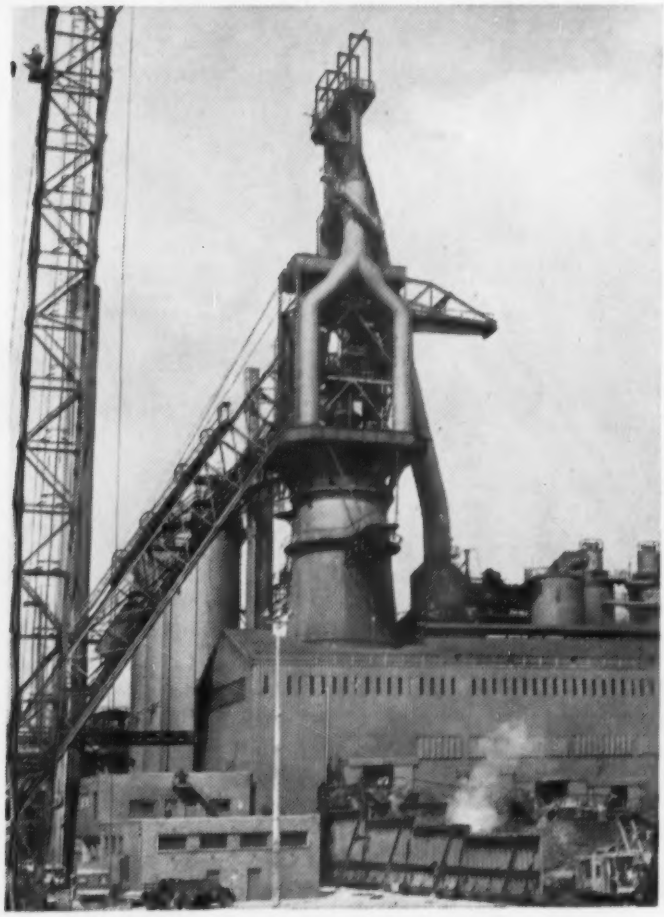
Exclusive European Representatives for the Fuller Manufacturing Company of Kalamazoo, Michigan, U.S.A.

AUTOMOTIVE PRODUCTS COMPANY LTD.
Brock House, Langham Street, London, W.1, England
Telephone: Langham 2527

Fuller TRANSMISSIONS

THE STEEL COMPANY OF WALES LEADS BRITAIN'S GROWING STEEL PRODUCTION

New blast furnace increases pig-iron capacity by over one-third



At the Abbey Works of The Steel Company of Wales, No. 4 Blast Furnace is now working at maximum capacity. Built last year, blown in this January, No. 4 Furnace has a hearth diameter of 29 ft. 9 in., the largest yet built by the Company. Its weekly output is over 10,000 tons of pig-iron.

No. 4 Blast Furnace has increased the Company's total pig-iron output by more than one-third and is contributing many extra thousands of tons of sheet steel and tinplate a week to Britain's home and export markets.

The Steel Company of Wales Ltd

All enquiries to the Sales Controller, Chesham House, 136, Regent Street, London, W.1.

NOW HERE IS THE FASTENER THAT IS QUICK, SIMPLE, SAFE AND STRONG

Shown here in the locked position, the Dzus Fastener is instantly unlocked by a quarter turn anti-clockwise. No special tool is required.

Cam operation ensures smooth easy working yet unbreakable grip ; fastener can be supplied of length to suit thickness of material.

Steel spring mounting lends great strength and guards against loosening, however intense the vibration.

DZUS FASTENERS

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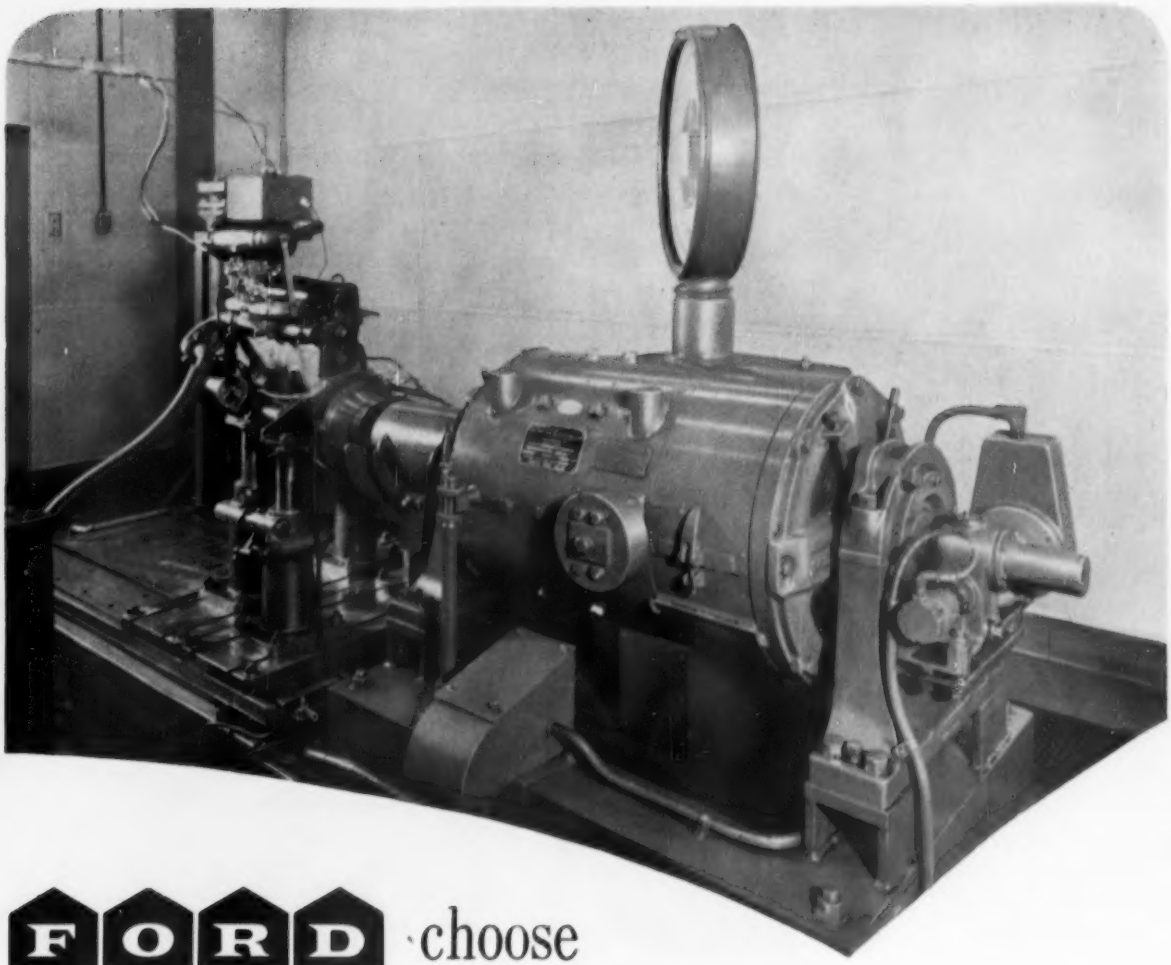

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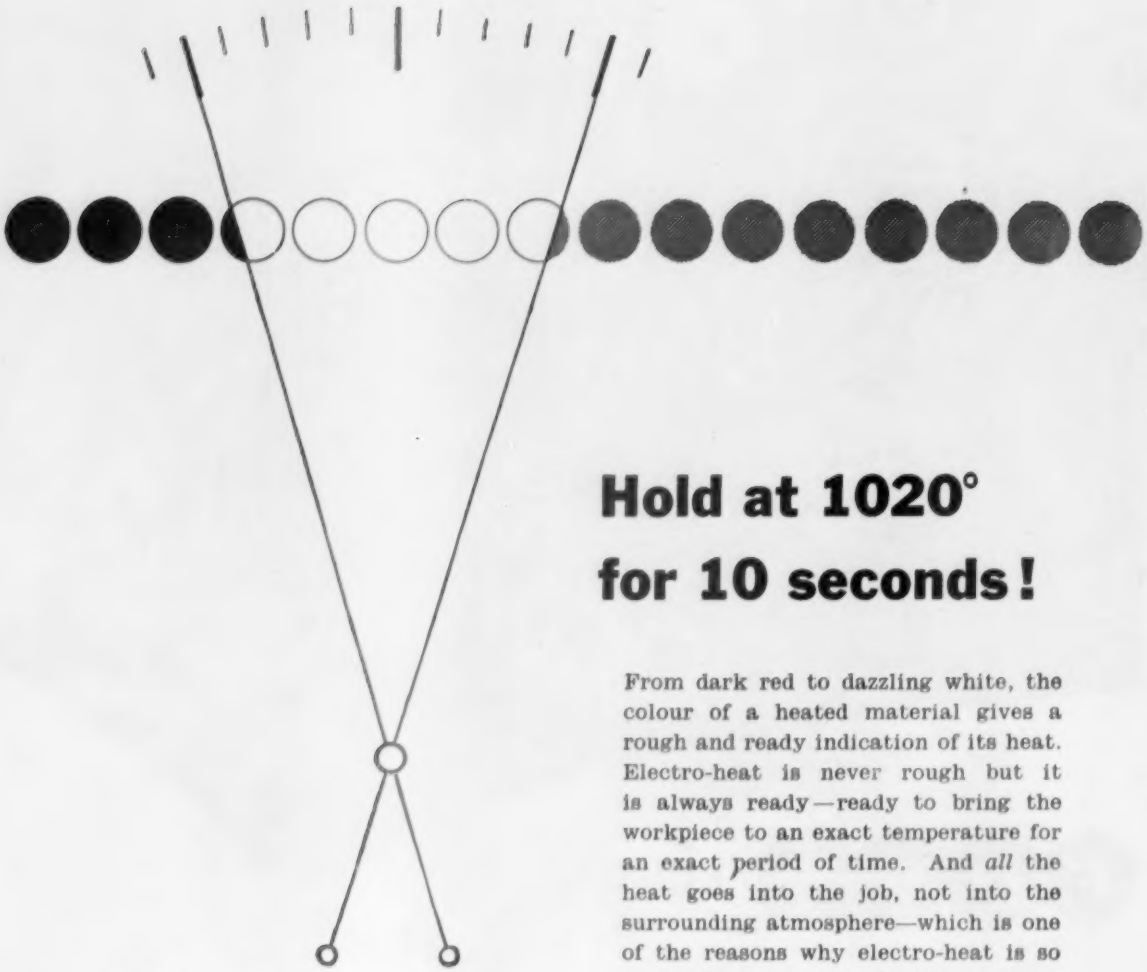

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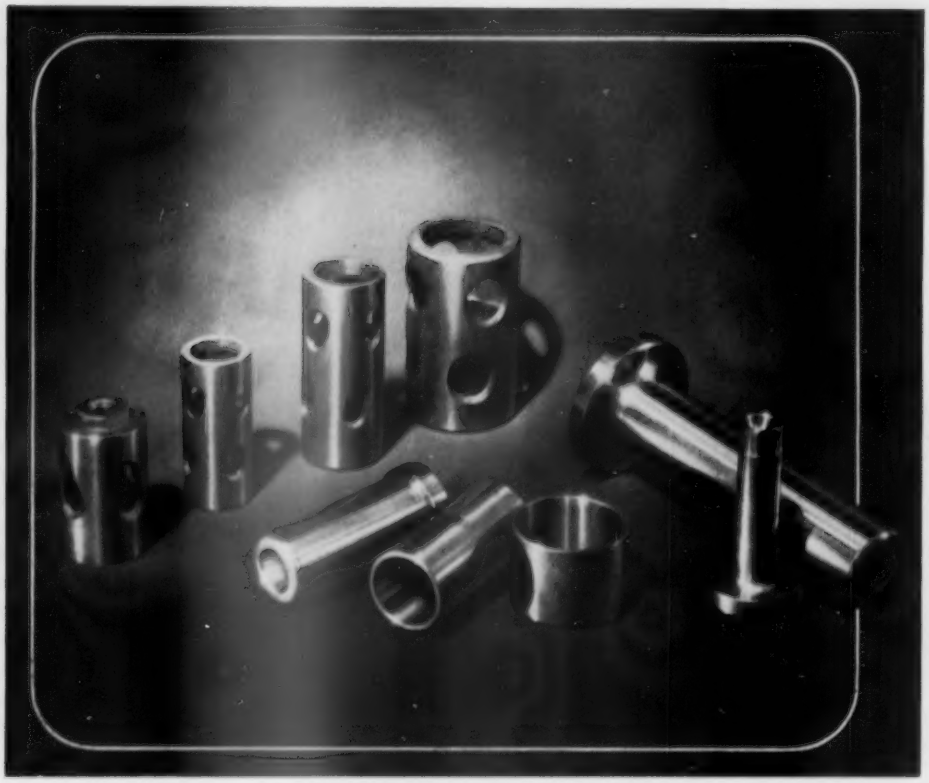

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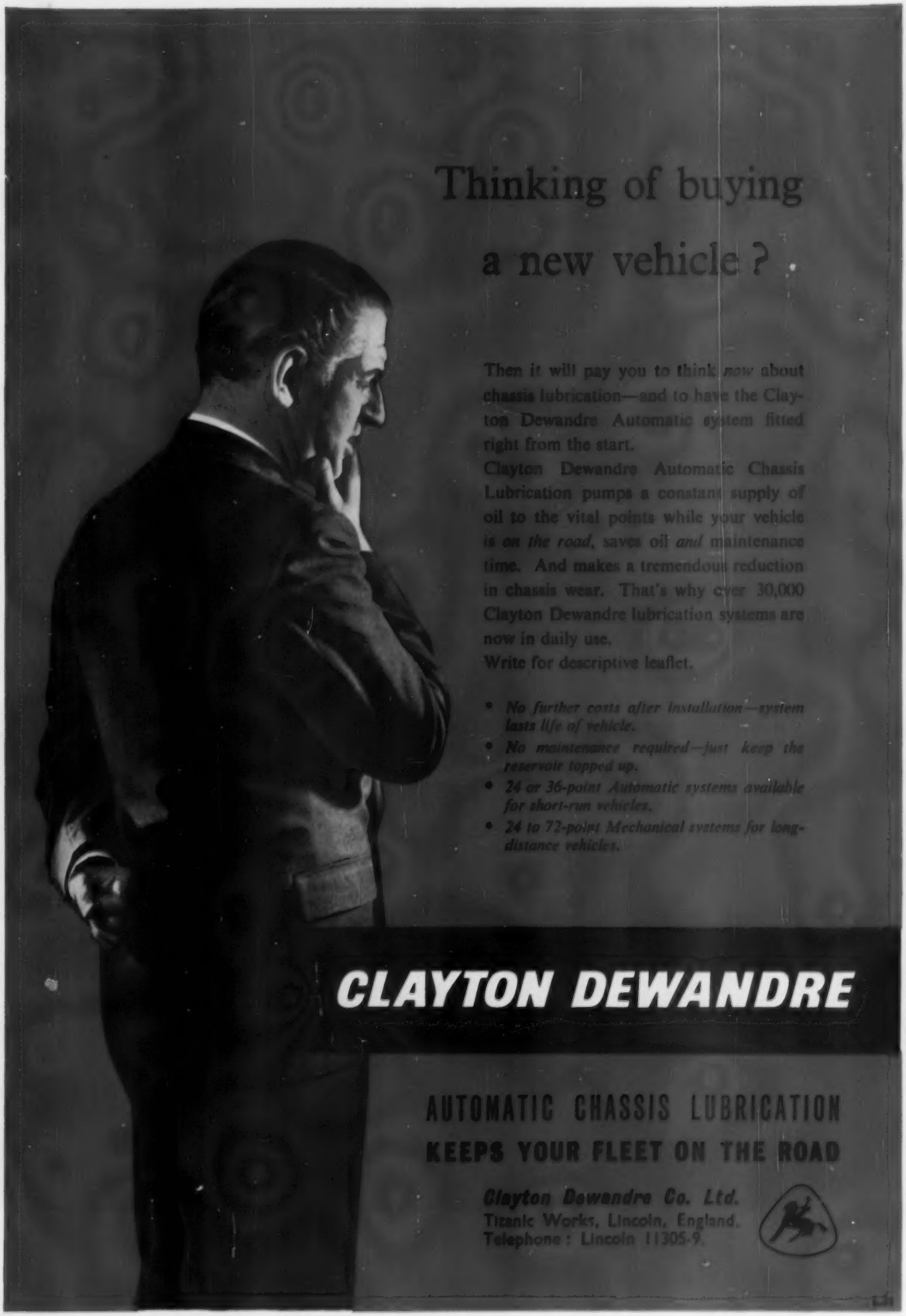
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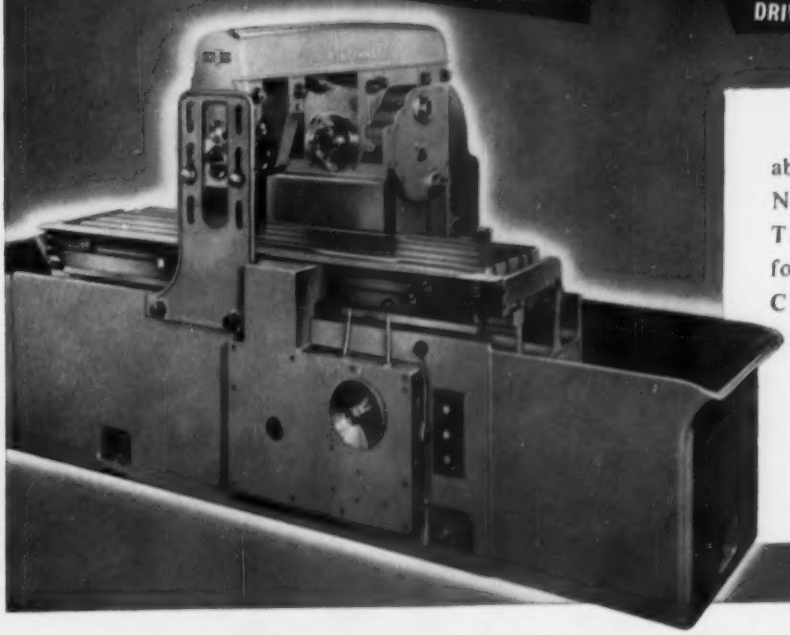

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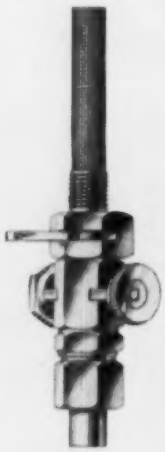

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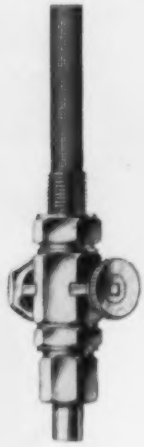

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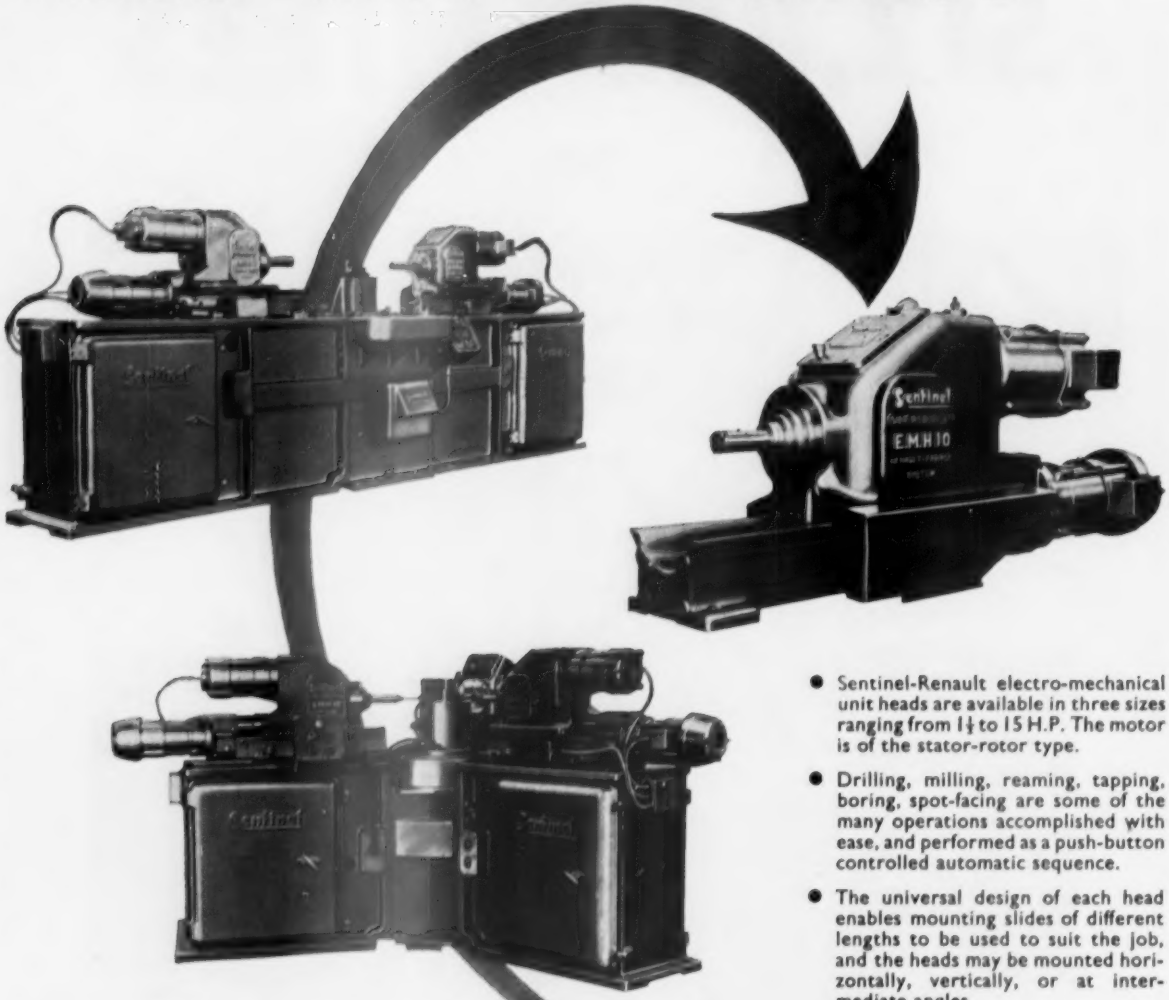

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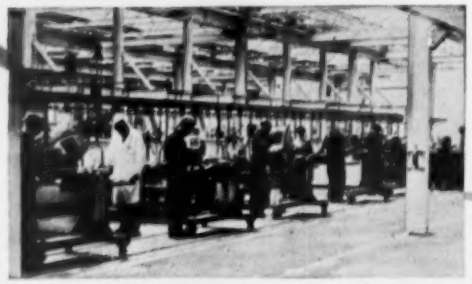

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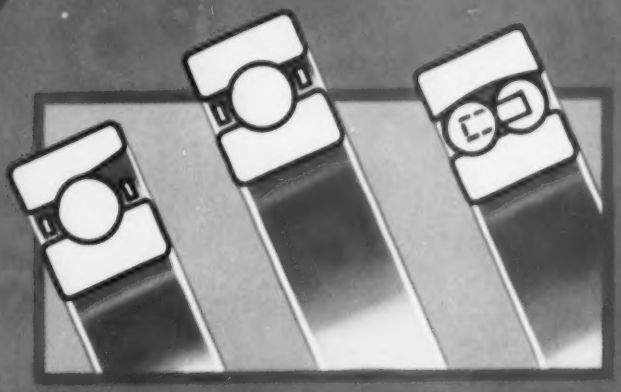

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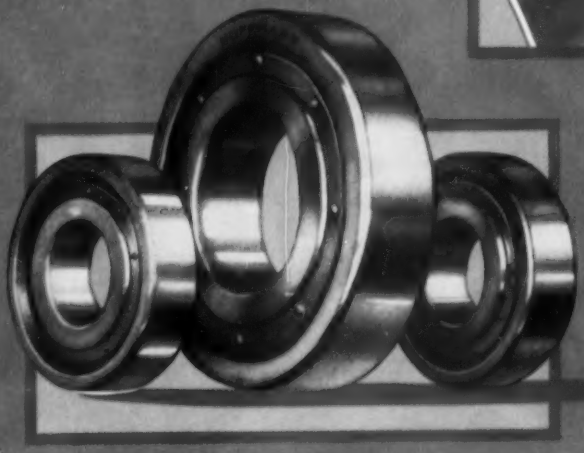

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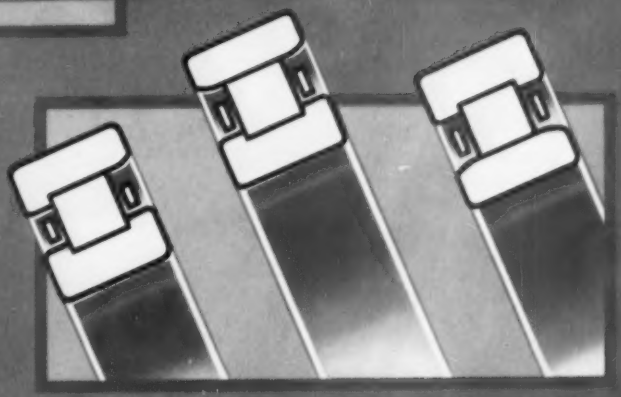

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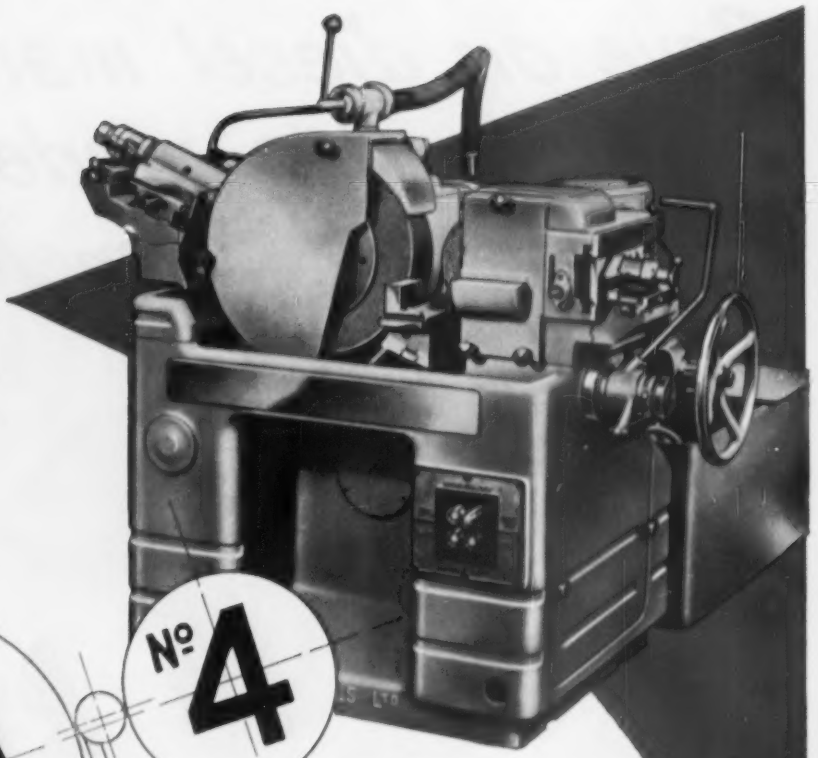

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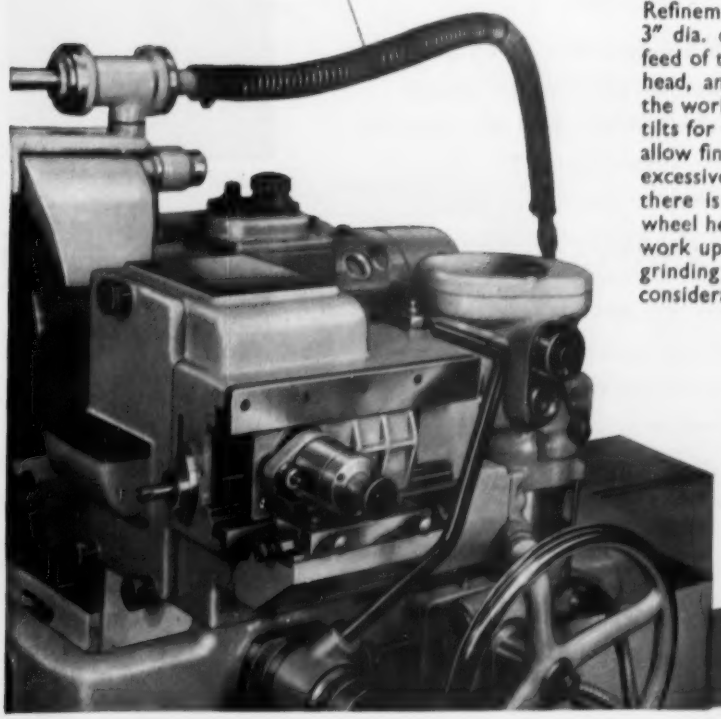

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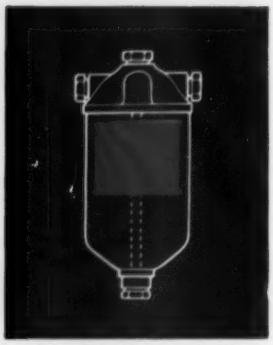
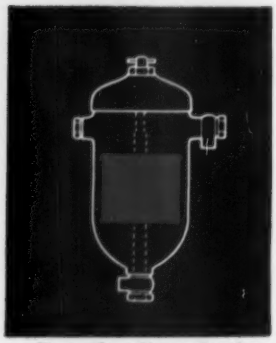
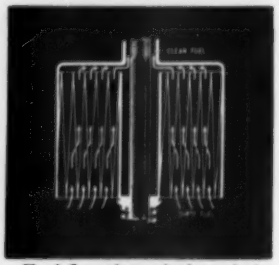


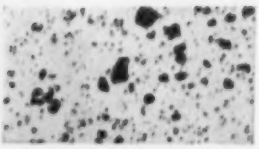
Cross-flow filter refitted with paper element.



Down-flow filter refitted with paper element.



Fuel flow through the spiral V-form paper element.



(a) Photomicrograph of fuel (x100) as supplied.

(b) Photomicrograph of fuel (x100) after filtering with the new element.

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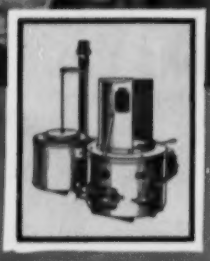

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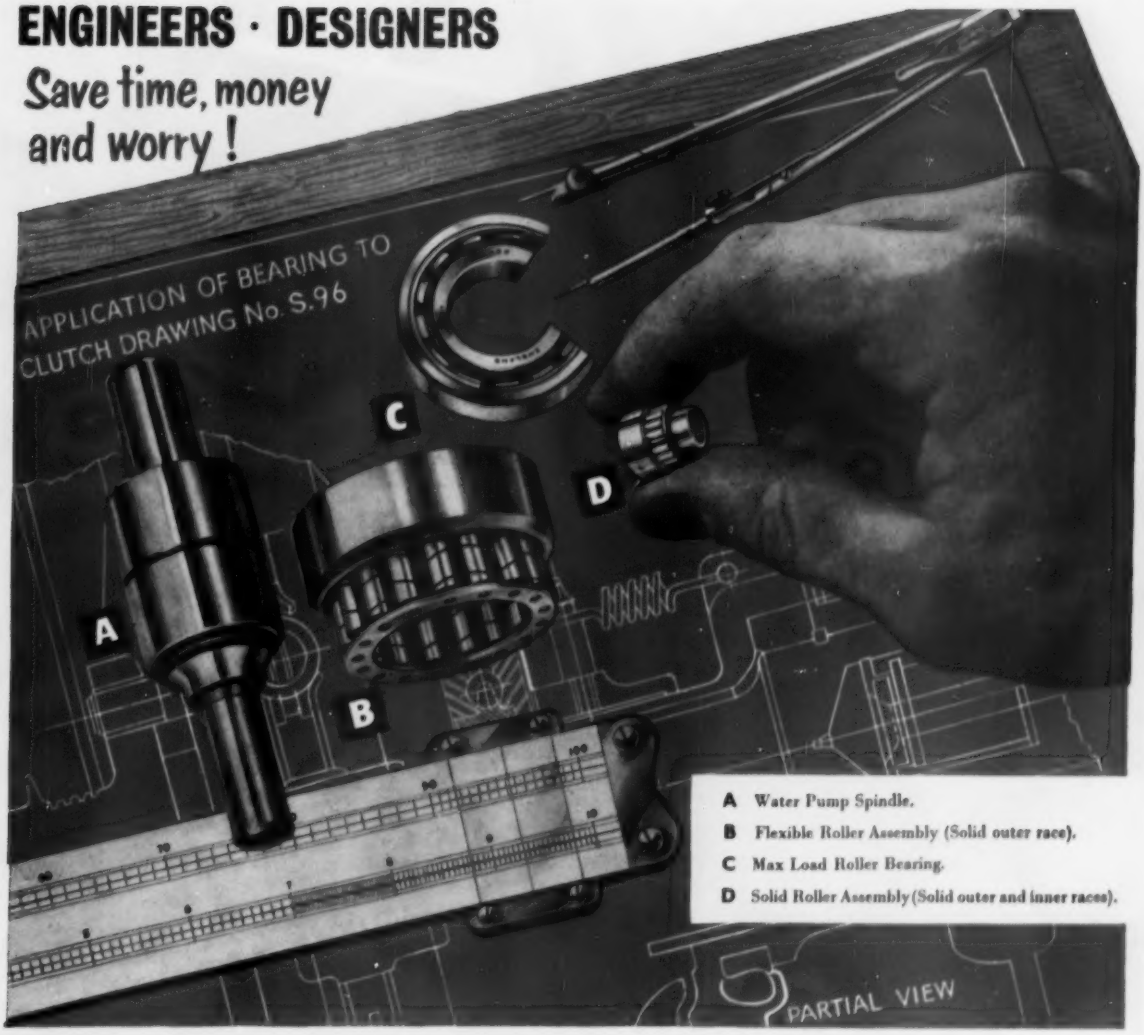
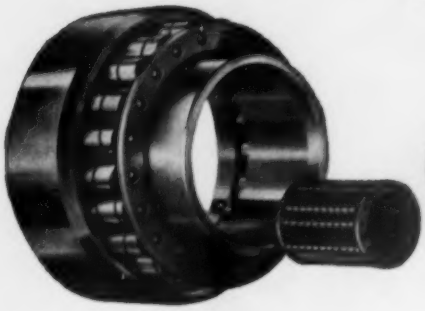


A Water Pump Spindle.
B Flexible Roller Assembly (Solid outer race).
C Max Load Roller Bearing.
D Solid Roller Assembly (Solid outer and inner races).



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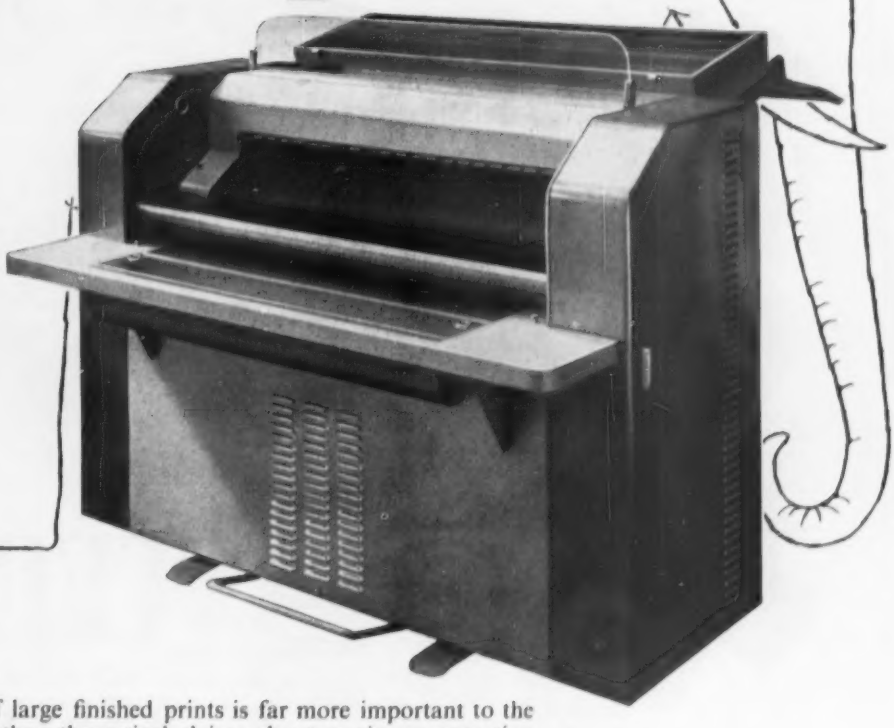

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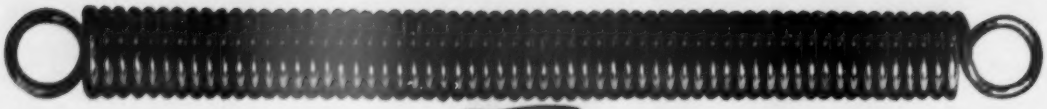

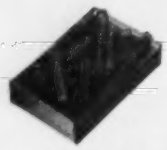

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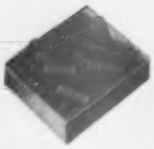

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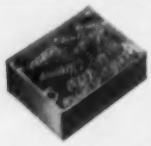

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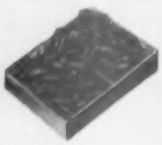

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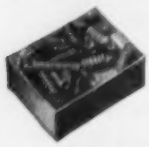

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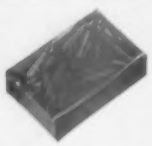

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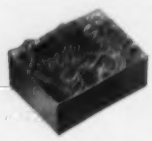

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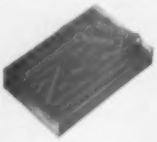

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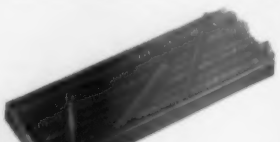

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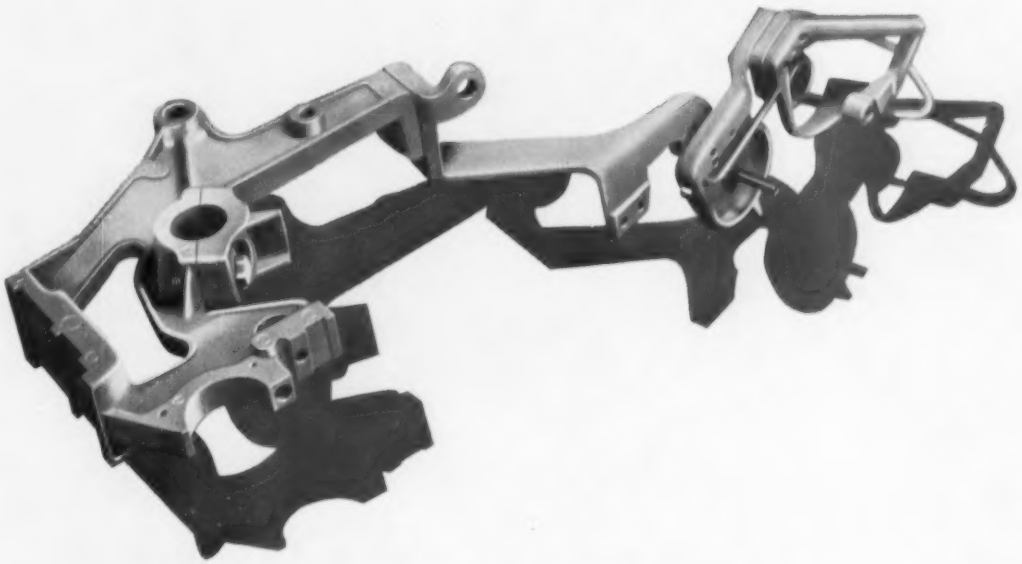

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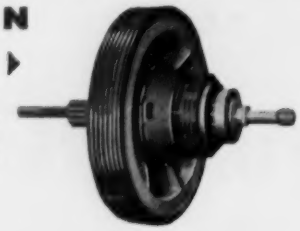

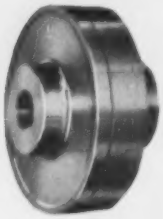

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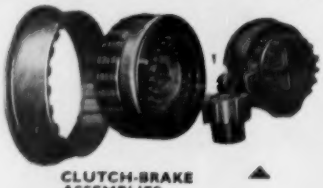

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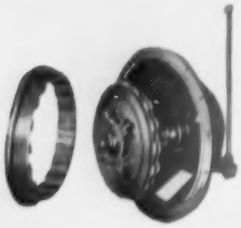

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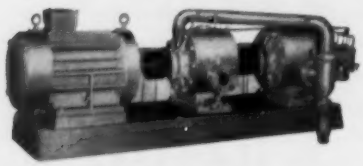

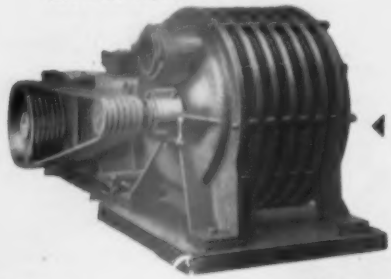

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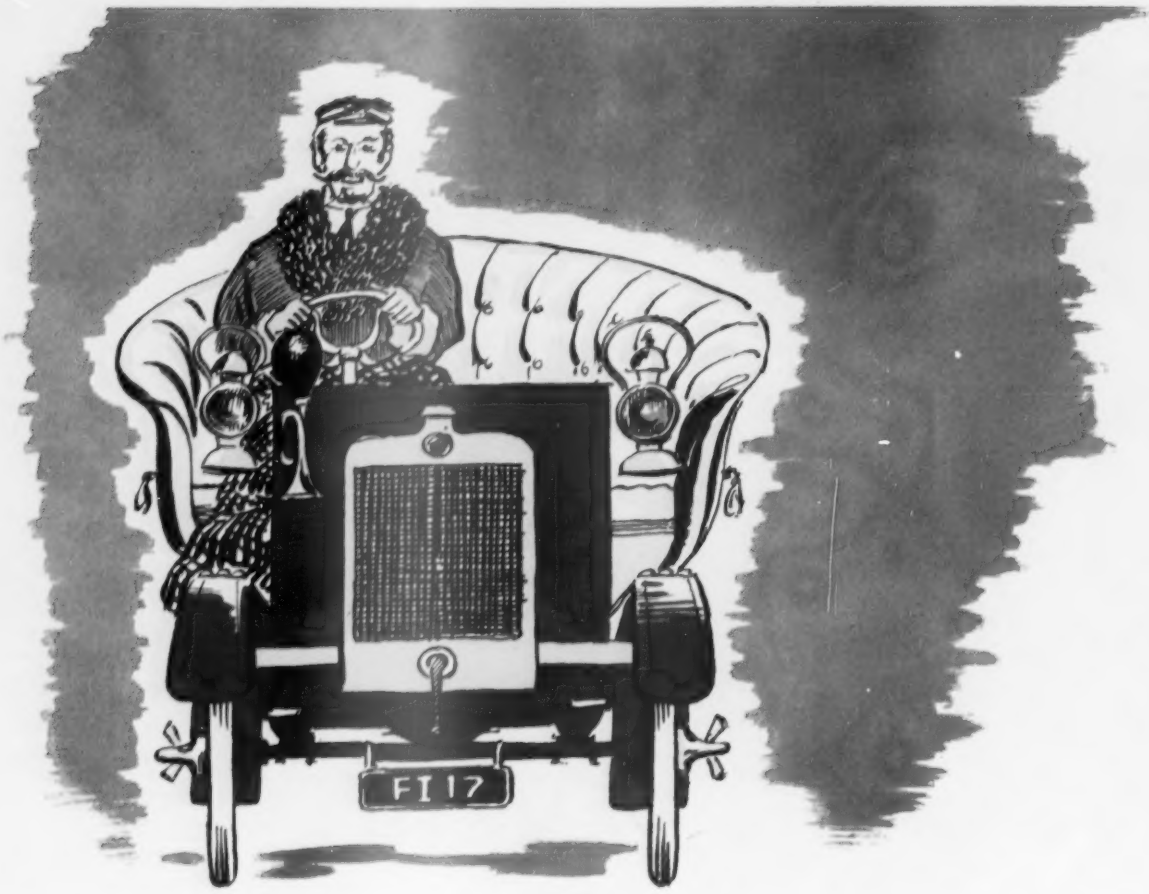

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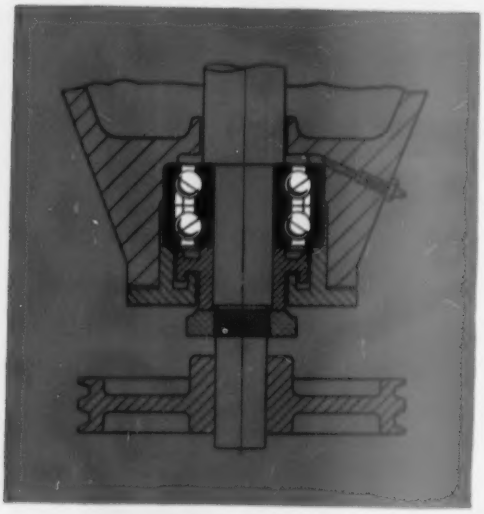

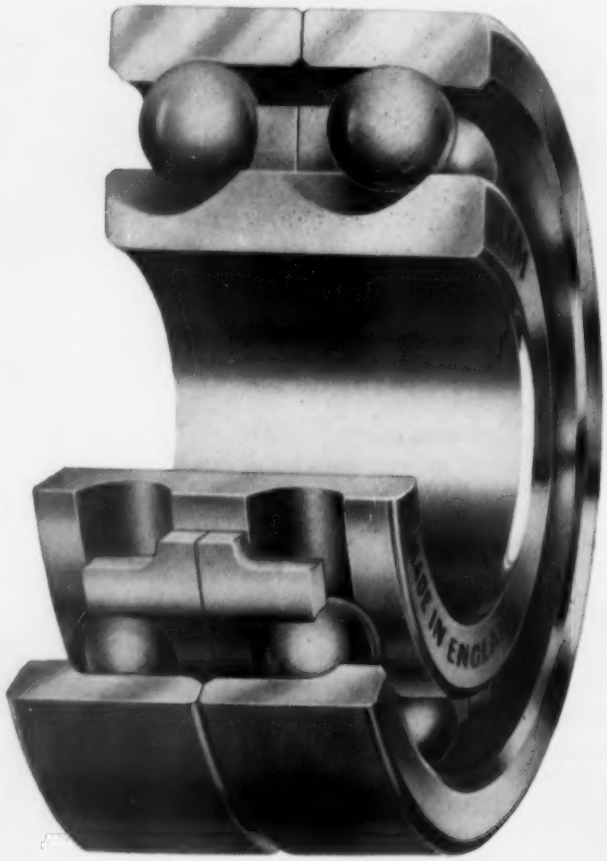

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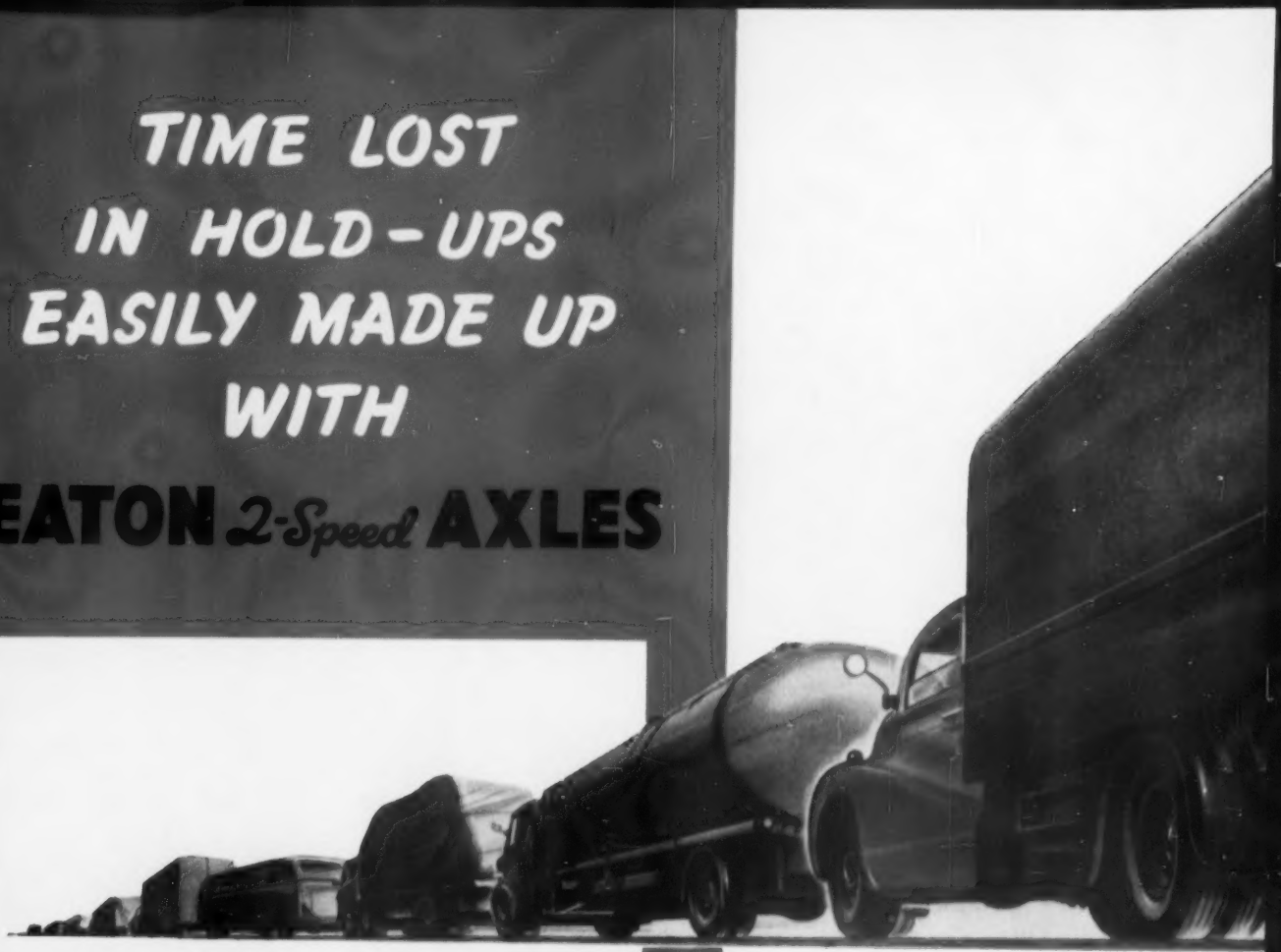

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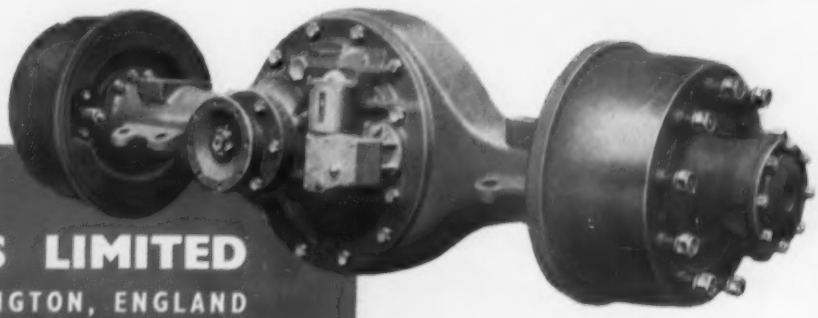

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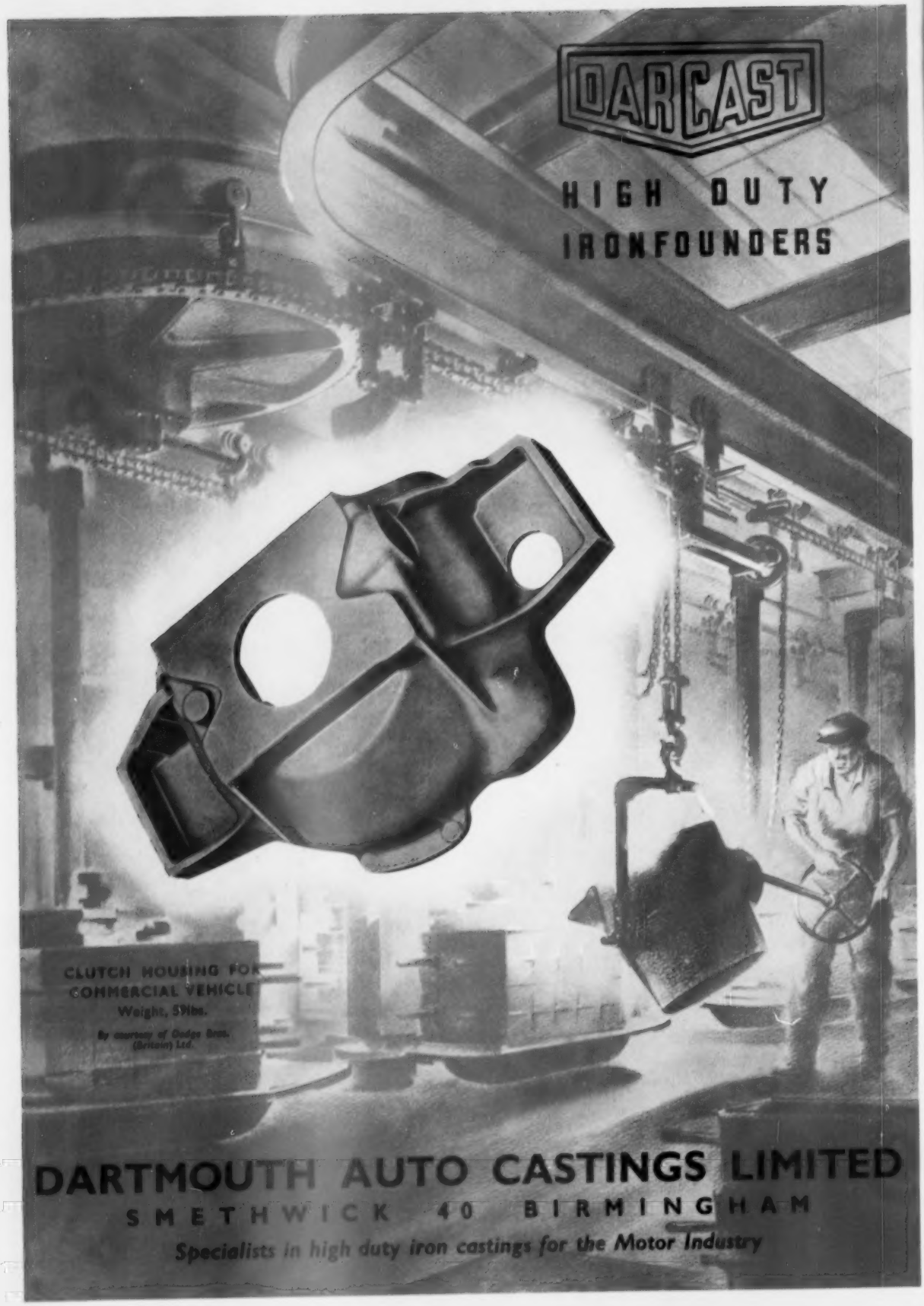
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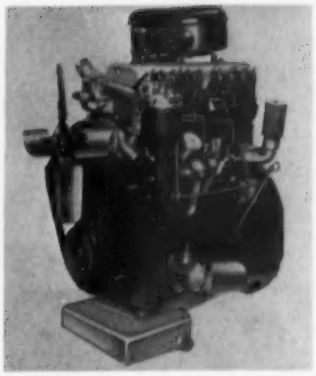

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COMMERCIAL VEHICLE EXHIBITION

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DESIGN MATERIALS **AUTOMOBILE ENGINEER** PRODUCTION METHODS WORKS EQUIPMENT

Engine Development

SPECULATION on the probable course of engine development is always both entertaining and useful. It is generally possible, by carefully tracing the path that developments have followed so far, and by extrapolation, to make a fairly accurate estimation of future trends. In studying these tendencies, it is necessary also to take account of the economic pressures that have influenced design in the past, and which are likely to be brought to bear in the future.

A factor that has hitherto had a marked influence on passenger car development, and which is likely to continue to do so, is that in most, if not all countries, even the least expensive motor car is economically beyond the reach of a large proportion of the population. As a result, effort has been directed continuously towards reduction of prime cost. This has been effected by attention to minute detail, and considerable pains have been taken to save small fractions of a penny. This trend towards greater production economy achieved by the drawing office is likely to continue, although so much has already been accomplished that it is doubtful if progress in this direction can be spectacular.

Such cheapening of the product has not been effected at the expense of either performance or reliability. In fact, persistent attention to both these aspects of design has resulted in marked improvement, and competition between manufacturers both in their own and in foreign countries has provided a stimulus. Again, with regard to either performance or reliability, the standard is already so high that it is difficult to see how any appreciable improvement can be obtained in the near future.

In recent years, more and more attention has been devoted to weight reduction. Economy in this respect has the advantage that if judiciously achieved, it can lead to reduction in prime cost and fuel consumption, and to improved acceleration. There is probably much more that can still be done to save weight, and this trend is likely to continue, although it certainly will be more marked in commercial vehicle engines because operators of this type of vehicle are even more insistent than are private car owners in their demands for reductions in weight and fuel consumption.

Improvement in mechanical efficiency has not received much attention and there would appear to be scope for advancement in this direction. In this aspect of design, as well as in weight reduction, improvement is only likely to be obtained by the same careful attention to detail as has been devoted to the lowering of production costs. There are innumerable ways in which friction losses can be reduced. For instance, some types of oil and water seals round rotating shafts give rise to greater friction losses than others. Water pumps can be improved to absorb less power, as also can fans. Careful investigation may show that certain types of bearing, although slightly more expensive than those more commonly used, might be attractive because they lead to greater economy of operation. A high proportion of friction losses in an engine occur, of course, between the piston and the cylinder bore. It would appear that there is scope for even more research to determine ways of reducing this friction. Recent advances in the technique of lubrication, such as the introduction of multi-viscosity oils, detergents and additives, may well justify further developments in the engine mechanism.

It is well known that features such as hemispherical combustion chambers can lead to improved performance in petrol engines, but the added expense of the rocker gear needed to actuate valves with these designs seems likely to continue to rule them out for the less expensive private cars. However, the current trend towards higher compression ratios might lead to a reconsideration of these aspects. Many other changes that can be made to reduce weight and increase performance are also out of the question because of the increased cost they entail.

So far as diesel engines are concerned, the currently accepted type of injection pump is likely to be replaced in many applications by the distributor type, which, of course, is less expensive. There is still room for improvement in injection characteristics.

Design for ease of servicing is an aspect that calls for more thought. Each new model sets a completely different set of problems and unless careful attention is devoted, during the design stages, to the servicing aspect, complaints and loss of good-will are inevitable.

The impact that the gas turbine will have on road transport is still an unknown factor. Experience with this type of engine is limited and it is not yet possible to discern trends that will provide some guidance as to its future development. However, it seems likely that it will be a long while before gas turbine powered road vehicles will be introduced commercially on a large scale. Most of the development so far undertaken has been devoted to power units for the more expensive passenger cars. The free-piston engine shows promise for application to both commercial vehicles and private cars, but this type tends to be less efficient as its size is reduced.

COMMERCIAL VEHICLE

Engines

Intensive Development of Small Diesel Engines Continues

THE 1956 Commercial Motor Show has not revealed any trends in engine development that were not previously apparent. All the new engines are of orthodox design and technical discussion of them has, therefore, to be confined to points of detail. For example, the new light diesel engine in the Commer and Karrier vehicles can hardly arouse the same technical interest as the opposed-piston two-stroke engine, introduced by the Rootes Group two years ago. This, however, is not adverse criticism of British manufacturers of commercial vehicle engines. Design changes, no matter how interesting they may be technically, must be introduced only when they can be justified on a sound economic basis.

There were more foreign exhibits than two years ago, but the number, nevertheless, was small and there is nothing to suggest that British engines are not holding their own successfully. The United States was represented by two Willys Jeeps, both powered by petrol engines; France by a motor coach with a Hispano-Suiza diesel engine. The exhibits from Germany, Sweden, Czechoslovakia and Holland are discussed later in this report, but none of these units reveals any important new development.

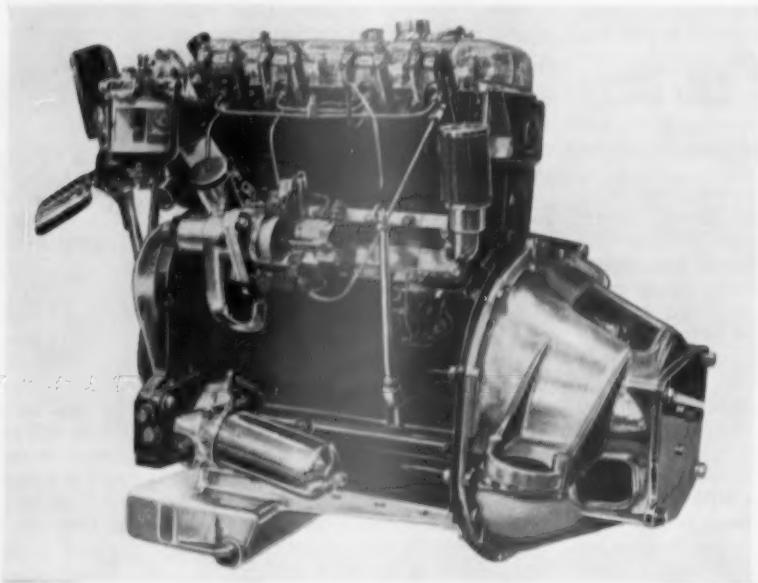
Two of the foreign engines were of the air-cooled V-layout. Of these, the German design was represented by one of a range of engines. Air-cooled units have several advantages, such as rapid warming-up, simplicity of cylinder design, and absence of freezing-up problems in cold weather, so it is perhaps for regret that there is no British vehicle powered by an air-cooled diesel. It can be argued that the orthodox, water-cooled, in-line designs of British origin have lent themselves more readily to conversion to horizontal installation, and that conservatism has been a fruitful policy. Nevertheless, it is to be hoped that the possibilities of a small air-cooled diesel engine for an all-climate tractor, say, will be given more attention.

Horizontal engine installation appears to be increasingly popular, although the number of power units specifically designed for this layout has not increased. In the past, horizontal units have in most instances been developed from existing vertical designs, but the current tendency is to bring out new engines in both forms. Some manufacturers have obtained greater power by increasing the bores of their existing designs. One has adopted wet cylinder liners to permit the greatest possible amount of power to be obtained, from the engine space available, without sacrificing reliability.

More supercharged engines might have been expected, but there seems to be considerable hesitancy in adopting this means of increasing engine power. The reason for this may be that hitherto there has not been any supercharger really well suited to transport applications. If so, the availability of the Wellworthy-Ricardo piston type supercharger, despite its more elaborate construction, possibly will have changed the situation in two years' time. German Eberspächer turbochargers are used by three different manufacturers who exhibited at the Show. The light weight and compactness of this unit makes it more suitable than most for transport engines.

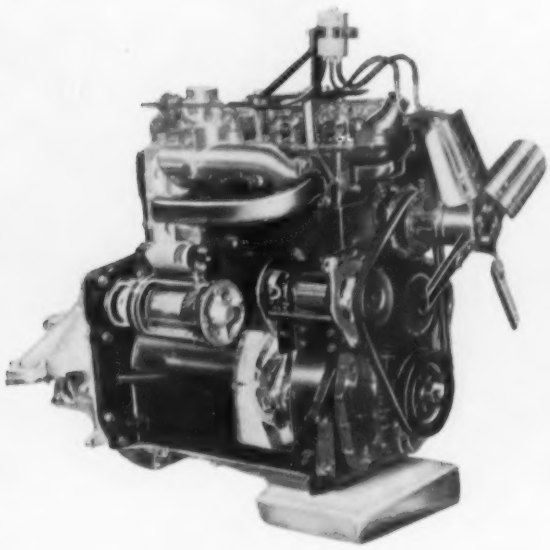
For power units with swept volumes of three litres and more, the open combustion chamber continues to be favoured by British manufacturers, the most popular form being a toroidal cavity in the piston crown. An exception is in the Perkins range, where a swirl chamber is used in units up to 5½ litres. On the small, high-speed engines, a swirl chamber in the cylinder head is generally used. No new two-stroke diesel engine has been produced, though the existing designs of this type appear to be popular. The availability of the Wellworthy-Ricardo supercharger might be an inducement to a fresh assessment of two-stroke potentialities.

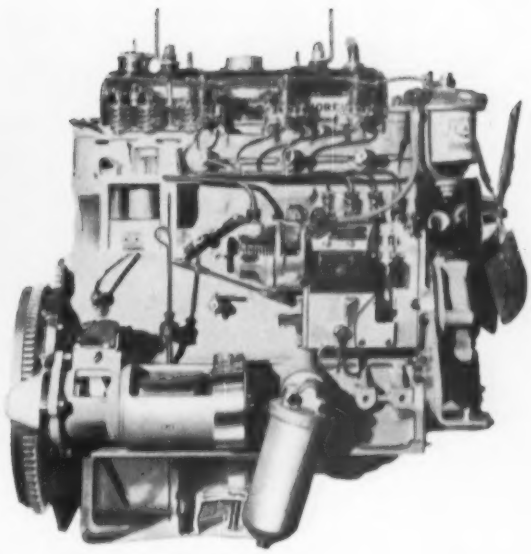
In spite of the continued incursion of the diesel engine into the light transport field, the petrol engine is still by no means routed from the medium range; in fact, petrol engines are still offered in vehicles of up to 10 tons payload. No doubt, much of the demand for petrol engines comes from overseas, where because of lower fuel costs, there is no justification for the expenditure of extra capital for purchase of a diesel engine. But, even in the British Isles, there will continue to be a demand for petrol engines for applications where the annual mileage is low. A case in point is the



The new 2.26 litre diesel engine for the Commer and Karrier light commercial vehicles has a distributor injection pump

EXHIBITION





Left: Right-hand side of the 2.26 litre diesel engine for the Commer and Karrier vehicles, showing the arrangement of the inlet and exhaust manifolds and the starter

Above: The B.M.C. 2.2 litre diesel engine has the same type of combustion chambers as are employed in the engine on the left

installation of a Rolls-Royce petrol engine in the new Dennis fire-engine chassis.

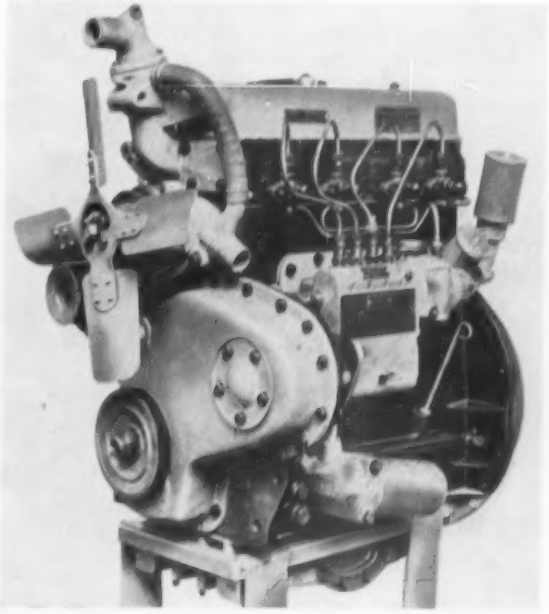
In view of the variety of engine types for which a theoretically sound case can be made out, we cannot but be impressed by the extent to which the four-stroke, in-line, water-cooled unsupercharged diesel engine dominates the British scene. There are some supercharged engines, a few two-stroke units and one opposed-piston engine. There is neither an air-cooled engine nor a V-type unit.

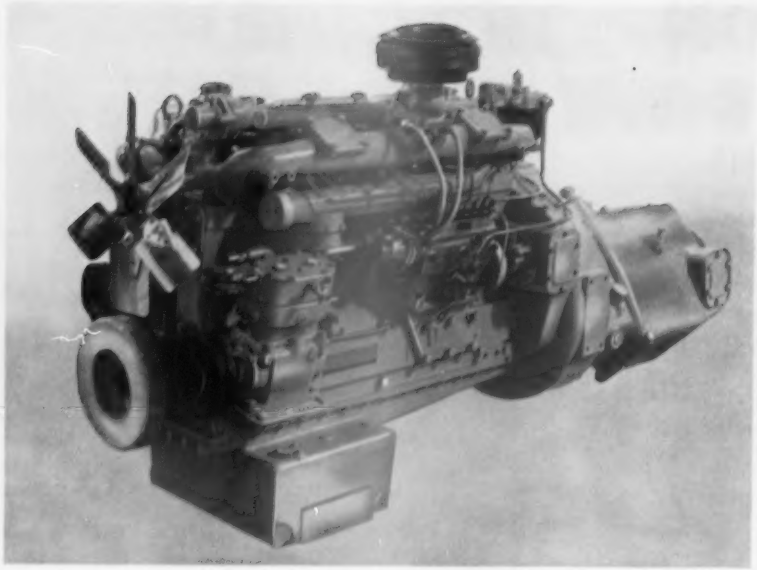
The gas turbine has not yet been introduced in the commercial field; in fact, greater efforts seem to have been directed towards its application to passenger cars, despite the fact that the case for its use in commercial vehicles appears to be much stronger. Although in the commercial vehicle field, the gas turbine has to compete with the highly economical diesel engine, whereas in cars it is competing with the petrol engine, the gas turbine is particularly suitable where large power output is required from a unit of low weight. It is therefore reasonable to assume that the gas turbine would be more readily applied as a power plant for heavy earth-moving equipment than for a medium-size saloon car.

The free-piston gas generator engine has also made its debut in the passenger car field, although, here again, it would appear that its application to commercial vehicles would have been easier. A small free-piston gas generator combined with a free-turbine might be developed to give a lower fuel consumption than the diesel engine, and it has the high starting torque of the ordinary gas turbine. However, the need to accommodate large compressor pistons means that the engine cannot compete with the gas turbine so far as compactness and lightness are concerned, and it is unlikely to equal the diesel engine in simplicity and reliability of operation.

The free-piston gas generator engine is, in effect, a supercharged, two-stroke diesel unit, in which all the diesel shaft power is used to drive the supercharger, while the output to the transmission is obtained entirely by passing the exhaust gases through a turbine. This concept suggests another type of compound engine, namely a two-stroke

It is of interest to compare the Standard 2.1 litre diesel engine, illustrated below, with the unit employed by the Rootes Group





Left: The Meadows 6DC500 engine is a six-cylinder 8.14 litre unit, developed from the 4DC330 four-cylinder model

Right: A number of minor design modifications have been incorporated in the Perkins R6 (V) 5.56 litre engine, the Mark II version of which is illustrated

diesel engine, whose power is absorbed by its rotary supercharger, and which delivers the exhaust gases under pressure to a free-power turbine. Such an engine would eliminate the bulky compressor pistons of the free-piston engine, but would require a crankshaft and a step-up gear for driving the supercharger, and starting would present some difficult problems.

The amount of work required before a reliable evaluation can be made of the economic importance of radically new designs is formidable. Nevertheless, we must hope that it is not so great as to deter our leading manufacturers from carrying it out. Only in this way can technical supremacy in the future be ensured.

Rootes

A new high-speed, four cylinder diesel unit has been introduced by the Rootes Group, for use in some Commer and Karrier vehicles. It has a Ricardo Comet Mk III combustion chamber, conventional dry cylinder liners and a C.A.V. distributor type injection pump. This pump, which is an innovation for British commercial vehicle engines, incorporates a variable-speed hydraulic governor. It is driven through an intermediate gear from the camshaft.

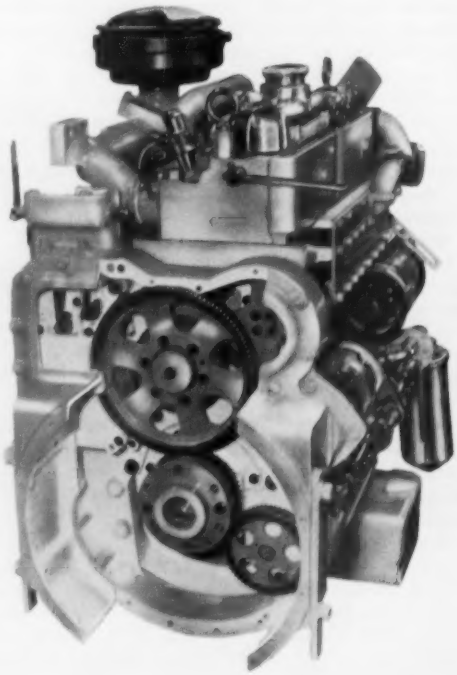
The bore and stroke of the engine are $3\frac{7}{16}$in and 4in respectively, giving a swept volume of 2,260 cm³ (137·9in³). Its compression ratio is 20 : 1. The unit develops 54 b.h.p. at 3,000 r.p.m. and gives maximum torque of 97·5 lb-ft at 2,100 r.p.m. Three shell type, main bearings carry the crankshaft. The chain drive to the camshaft has a hydraulic tensioner, the oil for which is supplied from the front bearing. Since the combustion chamber design is similar to the B.M.C. 2·2 litre engine, and the layout of the components is much the same as the Standard 2·1 litre unit, illustrations of all three engines are shown for comparison. The Commer two-stroke engine, with six opposed pistons, which was introduced in 1954, powers a Commer 7 tonner and a Commer 10 ton tractor.

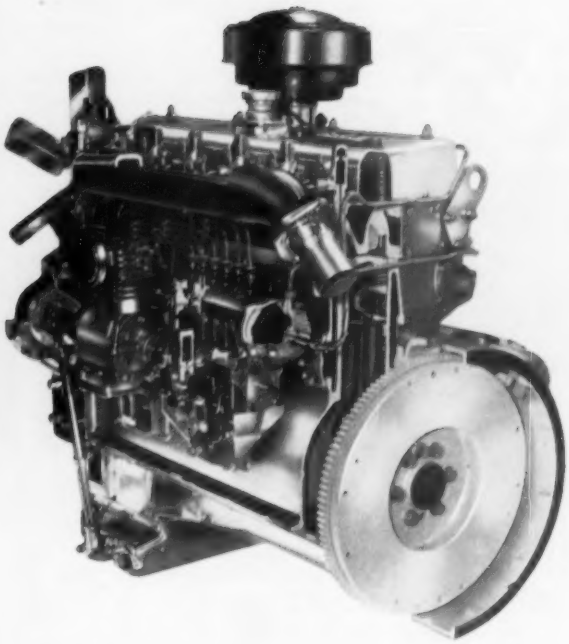
Meadows

Henry Meadows Ltd. have extended their range by the addition of four new oil engines. Two of them, the 6DC 500 vertical six-cylinder engine and the 6HDC 500 horizontal version, are developments from the four-cylinder 5·43 litre engine, which has been in service for several years. The four cylinder unit, of course, is fitted as a vertical engine in the Guy Warrior 8 ton goods vehicle and horizontally in the Warrior underfloor-engined chassis.

Like their forerunner, the two six-cylinder units have direct fuel injection with multi-hole fuel injectors. Toroidal combustion chambers are incorporated in the piston heads. A compression ratio of 16 : 1 has been adopted, and the bore and stroke are both 120 mm. The cylinder heads are made in three separate sections, each of which covers two cylinders,

This illustration shows the timing drive of the Meadows 4DC330 engine. The arrangement on the 6DC500 unit is similar





thus making for even pressure on the cylinder head joint. Valve seat inserts are used for the inlet and exhaust valves. The exhaust valves are Stellite-faced, and unmasked inlet valves are employed. An integral cylinder block and crankcase design has been adopted, and wet type liners are fitted.

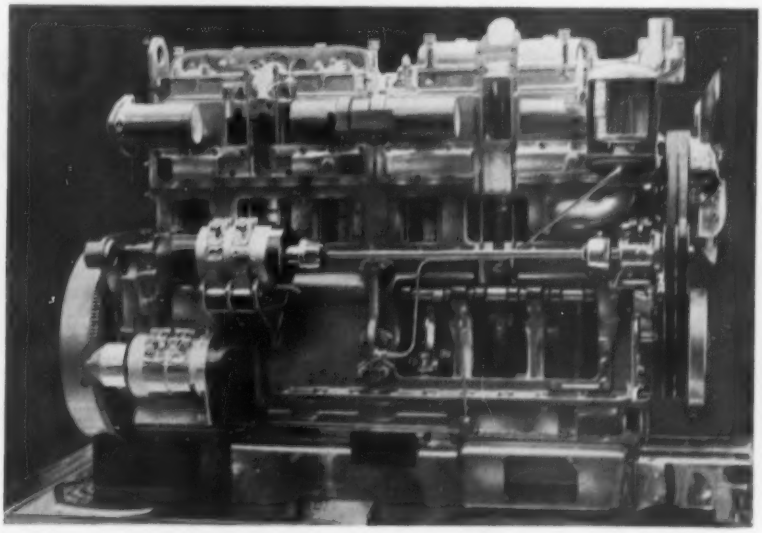
The crankshaft is carried in seven main bearings, and provision is made for full power take-off at the front end. The fuel pump is gear-driven from the rear of the engine in both the vertical and the horizontal versions. A maximum of 135 b.h.p. at 2,400 r.p.m. and a maximum torque of 346 lb-ft at 1,400 r.p.m. are quoted for both units. The swept volume is 497 in³; hence the designation "500". At maximum power and maximum torque, the fuel consumptions are stated to be 0·43 and 0 38 lb/b.h.p.-hr respectively. Normally a pneumatic governor is fitted to the fuel pump, but alternatively either a hydraulic or a mechanical governor can be used if required. The engines are intended for goods vehicles in the 12–14 tons payload class and for large coaches and public service vehicles. A vertical engine has already been installed in a Rowe Hillmaster 9 ton goods vehicle, and the Hillmaster passenger vehicle has been equipped with the horizontal unit.

Both the other new Meadows engines also have six cylinders. They are developed from the existing 10 35 litre six-cylinder unit. The 6HDC630 is the horizontal version of this engine, whilst the 6DCS630 is, like its predecessor, a vertical turbocharged version. Direct injection into toroidal cavities in the piston heads is again used. The bore and stroke are both 130 mm. In contrast to the 500 class, the 630 engines have dry cylinder liners, and the cylinder head is made in two interchangeable sections, each of which covers three cylinders. Both units have a capacity of 630in³, that is 10 35 litres, and a compression ratio of 16 : 1. Many major components are interchangeable between the two new units and their predecessor. The horizontal engine has the same output as the vertical one, that is, 130 b.h.p. at 1,900 r.p.m. and a maximum torque of 420 lb-ft at 1,000 r.p.m. It is intended for underfloor installation in goods vehicles of up to 16 tons payload, and for the largest stage-service vehicles.

An Eberspächer turbocharger, manufactured in Germany, is fitted to the supercharged engine. It increases the power output to 185 b.h.p. at 1,900 r.p.m., and the maximum torque to 540 lb-ft at 1,300 r.p.m. The power is thus increased by over 40 per cent for a relatively small increase in size and cost. To meet servicing requirements, there is an exchange scheme, whereby the turbocharger can be replaced after 30,000 miles of operation. The engine exhibited had been extensively tested in Germany and will shortly be installed in a vehicle of about 20 tons gross weight for road testing. It is to be expected that, because of the low inertia of the rotating components of this turbocharger, a rapid engine-response to increase in load will be obtained. The blower is of the centrifugal type, exhaust-driven by an inward-flow, radial turbine. The bearings are water-cooled and lubrication is independent of the main system.

Perkins

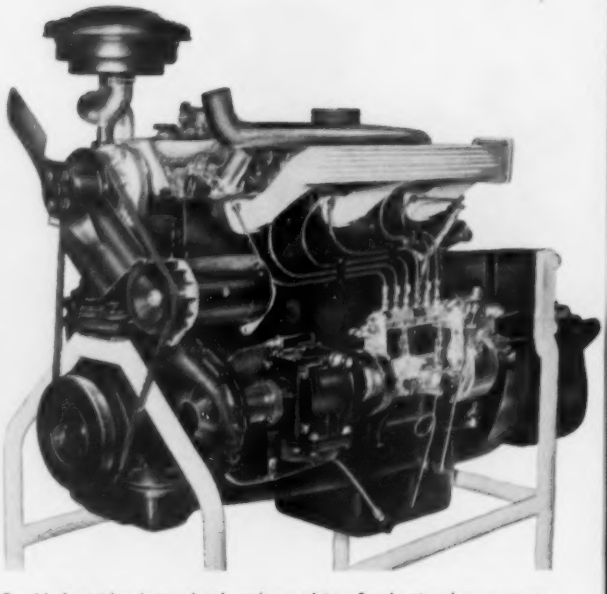
A new version of the Perkins six-cylinder, 5·5 litre, R6 vertical engine has been introduced. It incorporates a considerable number of modifications but retains the basic design of the earlier engine. The new engine is designated the R6 (V) Mark II. It develops 104 b.h.p. (gross) at 2,500



Leyland 0/900 engine sectioned to show the gear-driven camshaft and long push rods

r.p.m. and a maximum torque of 240 lb-ft at 1,600 r.p.m. The swept volume is 340 in³, and the compression ratio is 17·5 : 1. The bore and stroke are 4in and 4½in respectively. As is usual in the Perkins designs, the combustion chamber is incorporated in the cylinder head and features a spherical chamber connected to the main cylinder by a fairly wide passage. Each fuel atomizer has two sprays, one of which is directed into the spherical chamber and the other into the throat.

The design modifications introduced include a new fuel pump and exhauster coupling, in which the coupling disc is made from an asbestos fibre based material, impregnated with coarse graphite. The dimension between the central hole and the slots has been increased, and the coupling should have greater strength and wear-resistance. To improve water circulation, the diameter of the holes in the copper and asbestos cylinder head gasket has been increased and all are now beaded. Location of the gasket has been made more positive by reducing the diameter of two of the stud holes. The exhaust valves are now made from KE 965 with chromium plated stems, Stellited tips and seating faces, and a polished fillet under the head. Modifications have been made to the timing case and cover to accommodate an improved chain tensioner and to give better lubrication. Both the size and speed of the oil pump have been increased to give a greater oil flow; the relief valve is also larger and is therefore in a different position. A bigger oil filter, with an increased by-pass relief valve setting, has been used and the oil seal at the rear of the crankshaft has been redesigned. An automatic altitude control is now available as an optional extra for restricting the maximum fuel setting at increased altitudes.



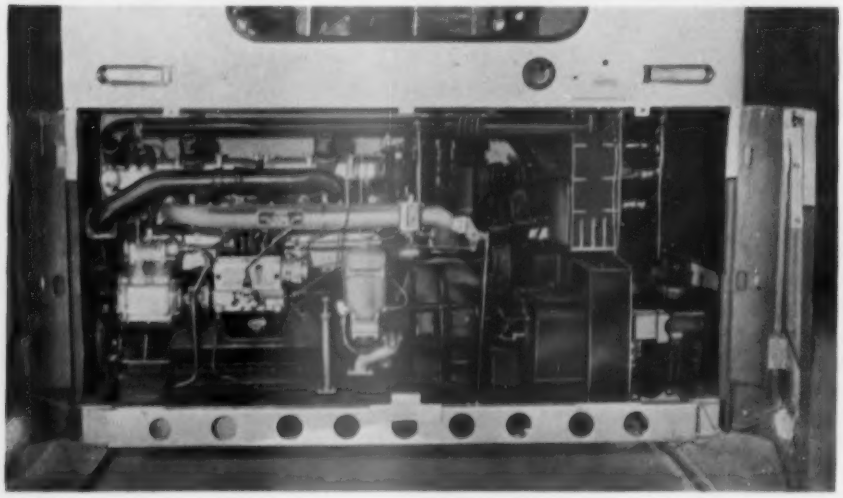
Fan blades with a large chord, and gear drives for the timed components are features of the Thornycroft JR6, 4.2 litre engine

Leyland

Leyland Motors Ltd. showed their new 15 litre engine, which is a six-cylinder 900 unit of 926·2in³ capacity. It has a bore of 5·5in and a stroke of 6·5in. The engine develops maximum power of 200 b.h.p. at 1,800 r.p.m. and maximum torque of 658 lb-ft at 1,000 r.p.m. A Leyland toroidal combustion chamber is incorporated in the piston crown, and four-hole fuel injectors of Leyland manufacture are employed. The compression ratio of 15 : 1 is slightly less than that of the 600 engine, which is 15·75 : 1. There are two identical cylinder heads. Each covers three cylinders and has renewable valve seat inserts and valve guides. Wet liners are used instead of the dry type commonly employed on Leyland engines. It is claimed that these wet liners are particularly easy to remove and replace.

A torsional vibration damper is fitted externally. The camshaft and fuel pump are driven from the front of the crankshaft, through helical gears. A right-angle helical gear pair drives the oil pump from the camshaft. This pump feeds the lubricant to a by-pass filter of the centrifugal type. The C.A.V. fuel pump houses a mechanically-operated governor, which controls the rack from an idling speed of 400 r.p.m. up to maximum speed. This powerful engine is supplied in vertical form for use in heavy transport vehicles, tractors, and earth-moving equipment. Also at the Show was a horizontal version for use in British United Traction railcars.

Another Leyland exhibit of particular interest was the Atlantean double-decker bus, with a Leyland 0/600 diesel engine at the rear. This engine is vertically mounted with its crankshaft parallel to the axle. It is readily accessible through large hinged doors. There are two special features that are not embodied in the prototype, but which may be incorporated at a later stage. First, the engine fan can be



In the Leyland Atlantean bus, with its engine transversely-mounted at the rear, the radiator is installed over the gearbox

used either to force fresh air through the radiator into the saloon or to extract air from the saloon and discharge it to the atmosphere, or recirculate it into the saloon. The second feature, which will be greatly welcomed by many road-users, is the discharge of the engine exhaust through a vertical pipe emerging from the roof of the vehicle.

The Albion EN287 engine is similar to the previous EN286 engine, but the bore has been enlarged from 4¼in to 4½in. This four cylinder unit has a stroke of 5½in. The increase in bore has changed the power rating from 75 b.h.p. at 2,000 r.p.m. to 93 b.h.p. at 2,200 r.p.m.

Thornycroft

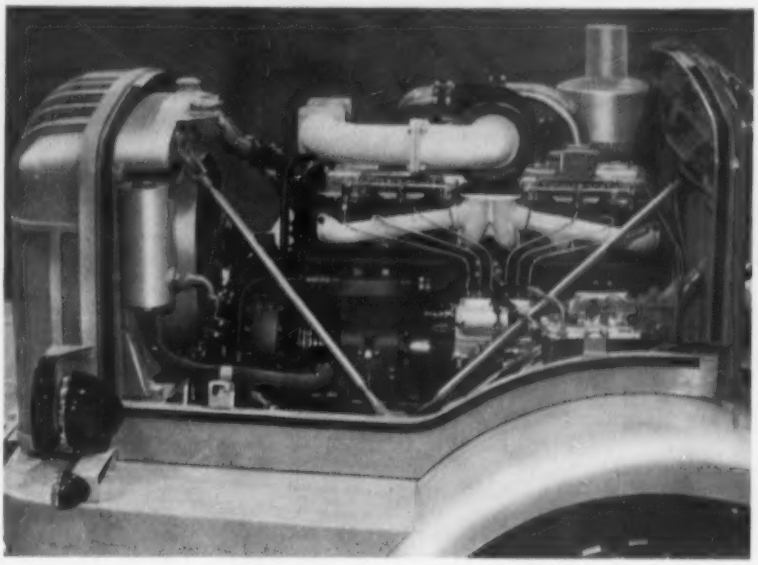
The new Thornycroft JR6 and QR6 oil engines were displayed at the Show in Swiftsure and Trusty vehicles, which have gross weights 9 tons and 24 tons respectively. The JR6 is a vertical, six-cylinder unit of 252in³ (4·18 litres) capacity. It develops 80 b.h.p. at 2,600 r.p.m. and maximum torque of 184 lb-ft at 1,600 r.p.m. The cylinder dimensions, 3⅛in bore and 4½in stroke, are the same as for the TR6 engine. However, the performance is considerably improved, partly by the increase in engine speed. Direct injection and toroidal combustion chambers are again used, and the compression ratio is 16 : 1. The QR6 engine is also of the six-cylinder, direct injection, vertical layout. It has a capacity of 9·83 litres, a bore of 4·75in and a stroke of 5·65in. Maximum power output of 130 b.h.p. is developed at 2,000 r.p.m. and maximum torque of 430 lb-ft at 1,200 r.p.m. As on the smaller engine, dry cylinder liners and a toroidal combustion chamber are employed. Also exhibited was a Thornycroft Big Ben chassis of 34 tons gross weight, powered by an 11·3 litre six-cylinder, KRN6 engine. This unit is fitted with an Eberspächer turbocharger and is rated at 200 b.h.p.

Turner

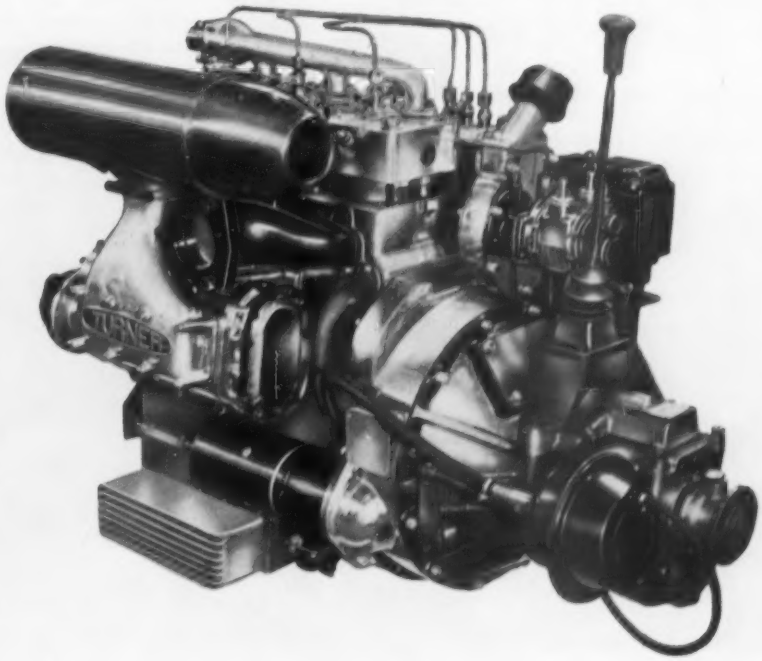
A Turner two-stroke, three-cylinder oil engine has been designed for installation in conjunction with the Manumatic control. This is the first application of the Manumatic system of two-pedal control to an oil engine. Since, in this system, the clutch and throttle are operated by vacuum servo units, a source of vacuum is required. With petrol engines, this source is the induction manifold. However, on the Turner engine, the vacuum is obtained from a simple rotary-vane pump, of Turner design, which is coupled directly to the fuel injection pump. The Manumatic system requires rapid engine response to throttle movement and the direct mechanical governing and fuel control of this engine therefore make it particularly suited to this system.

Daimler

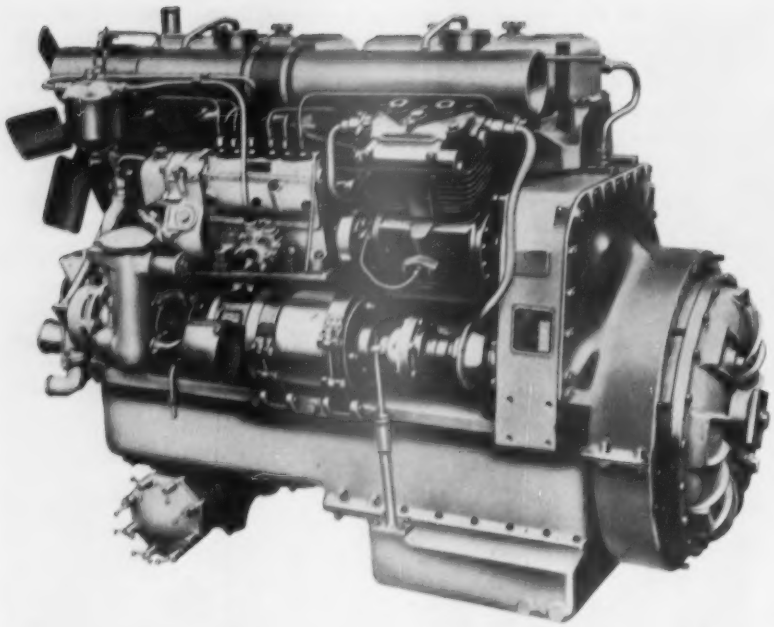
The Daimler CD650, vertical six-cylinder engine and its horizontal version, the D650H, are now available as separate units: hitherto, they were available only in the Daimler



Above: Thornycroft turbocharged 11.3 litre engine installed in the Big Ben export chassis



Right : On this Turner three-cylinder, two-stroke diesel engine, the vacuum pump for the Manumatic control is installed beside the fuel pump. The clutch servo is mounted on the gearbox



The Daimler 10.6 litre, 5in bore and 5½in stroke, engine equipped with a fluid flywheel

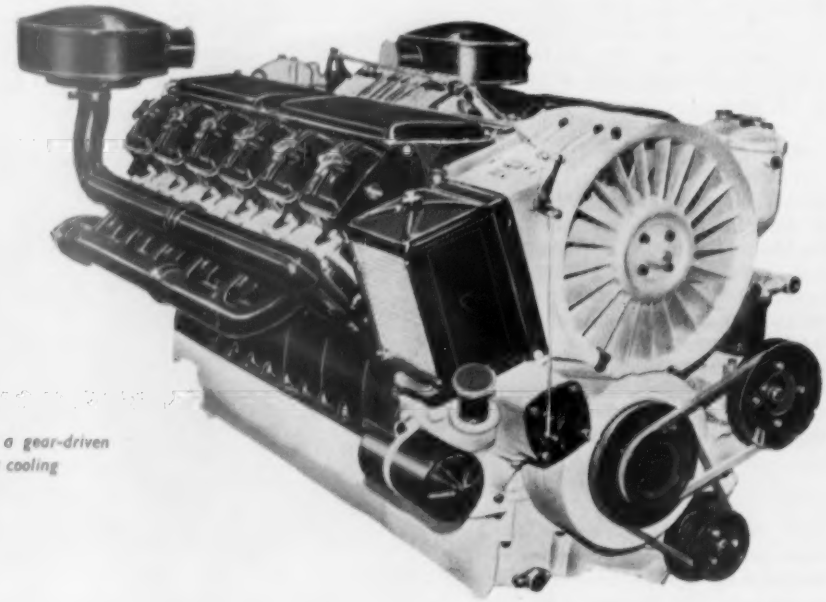
chassis. The engines have direct injection and two interchangeable cylinder heads, each covering three bores. The fuel pump and camshaft are gear driven from the rear of the crankshaft. Both engines have a capacity of 10·6 litres and deliver 150 b.h.p. at 2,000 r.p.m.

Miscellaneous features

The British Motor Corporation range of oil engines, comprising the 2 2, 3·4 and 5·1 litre engines, continues unaltered and the group now manufactures all its oil engines. Vehicles of 1 ton, 1½ ton, 4 ton and 5 ton payload are offered with the alternatives of petrol or oil engines, but the 7 ton vehicles are supplied only with the 5·1 litre oil engine.

There is nothing new to report on the Rolls Royce series C oil engines, which have been but little changed. Their basic cylinder dimensions are 5½in bore and 6in stroke. Four-, six- and eight-cylinder vertical, or in-line, units are made, either supercharged with a Roots type blower or normally aspirated. Since the engines were designed for supercharging, the normally aspirated versions are much derated. The six- and eight-cylinder engines are also available in horizontal form for underfloor mounting, and emphasis is placed on the way in which components and accessories can be mounted in various ways to suit different installations and to facilitate maintenance.

The Ford four-cylinder, direct injection diesel engine is still in production and is available in the 4 ton vehicle as well as in the 3 ton one. This 3 6 litre engine develops a maximum power of 60 b.h.p. at 2,400 r.p.m. It has a compression ratio of 16 : 1. The four-cylinder petrol engine alternative



On the Deutz V12 air-cooled engine, a gear-driven axial flow fan is incorporated for cooling

has the same capacity, bore and stroke, but develops a maximum power of 70 b.h.p. at 2,800 r.p.m.

Alternative petrol or diesel engines are offered for the Bedford range of vehicles from 25 cwt up to 10 ton payload. The diesel units are the Perkins four- and six-cylinder engines. Only on the light vans is the petrol engine fitted as standard. The A.E.C. range of six-cylinder oil engines, comprising the 7·7, 9·6 and 11·3 litre engines in vertical or horizontal form, is continued. These were described in detail in the October 1954 issue of *Automobile Engineer*.

Germany

Germany was represented by Volkswagenwerk G.m.b.H., who exhibit their well-known van, and by Magirus Deutz. Klockner Humbolt Deutz A.G. can be traced back to its foundation in 1864 by Otto and Langen, later they transfered their interest from gas engines to petrol engines, and then to diesel engines. Manufacture of diesel engines was begun in 1900, but the first air-cooled diesel was not run until 1942. Deutz claim to be the largest manufacturer of air-cooled diesel engines, and produce a large range all with the same basic cylinder design. The forms available are a four-cylinder in-line engine, a V6, a V8 and a V12 unit. The V12 engine, which is the latest design, was on display at the Show.

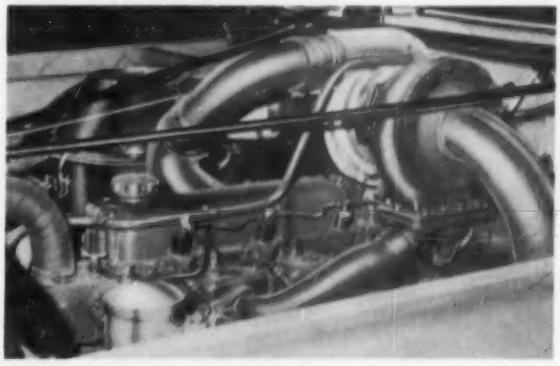
The whole range are of the four-stroke, overhead valve design, with a grey cast iron pear-shaped swirl chamber cast in each aluminium cylinder head. A glow plug is mounted beside the fuel injector at the top of the swirl chamber. The valve guides and seats are of cast iron. All the cylinder heads of the range are interchangeable both on each engine and between engines of different form. Interchangeability is also a feature of the cylinder barrels, pistons, valves and injectors. In all, there are 97 parts that are common to the whole range. The cast iron cylinder barrels are individually constructed, and each is fixed to the crankcase by four, long bolts, which also serve to secure the cylinder head to the barrel.

On the V-engines, a single camshaft is carried between the cylinders. At its rear end is a helical gear, which drives a long shaft that drives the axial-flow cooling fan at the front of the engine. This fan delivers air into the space between the two banks and thence out between the cylinders. All the cylinders have a bore of 110 mm and a stroke of 140 mm, giving a capacity of 1·33 litres each. Therefore, the total capacity of the twelve-cylinder engine is 16 litres. For automotive applications, the rating of this engine is about 250 b.h.p. at 2,300 r.p.m. and the maximum torque is 666 lb-ft at 1,200 r.p.m.

Czechoslovakia

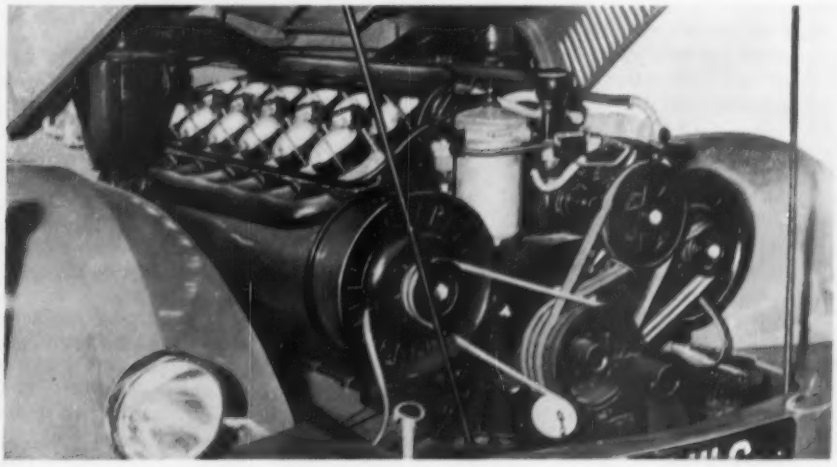
Another V12 air-cooled engine was shown installed in a Tatra truck of 10 tons payload. This direct injection engine is slightly smaller than the Deutz unit. It has a capacity of 14·825 litres and a rating of 180 b.h.p. at 1,800 r.p.m. The bore and stroke are 110 mm and 130 mm respectively and the compression ratio is 16·5 : 1. A five-hole injector discharges into a toroidal cavity in each piston head. Separate cast-iron cylinder heads and barrels are employed and are secured to the crankcase by four, long bolts, as on the Deutz engine. They are interchangeable. The crankshaft is made up in several sections, screwed together. Each section is an iron casting, and the assembled shaft is carried in seven roller bearings. The cooling arrangements differ from the Deutz engine in that two axial fans are used, belt-driven from the front of the crankshaft. If required, the engine rating can be increased to 220 b.h.p. at 2,200 r.p.m. A six-cylinder in-line engine, which is, in effect, half the V12 engine, is also produced.

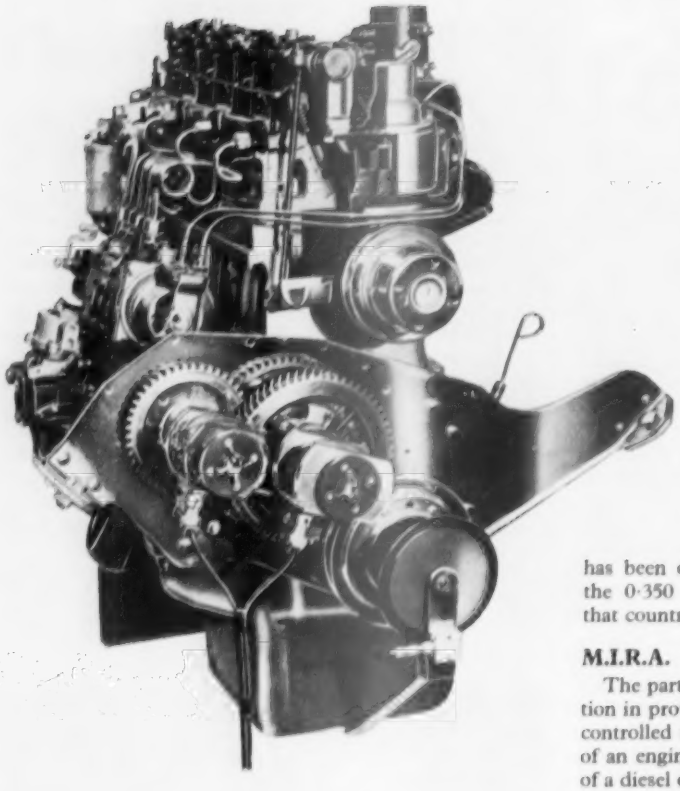
Another Czechoslovakian exhibit was a Skoda truck of 10 ton payload, in which was installed a six-cylinder water-cooled power unit of 11·8 litres capacity. The engine,

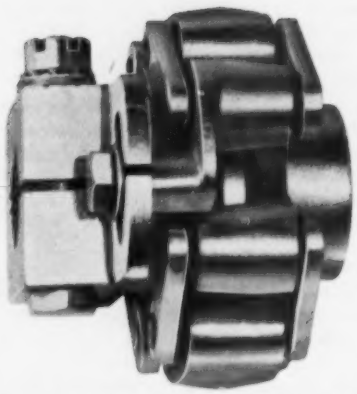


Above: Twin exhaust manifolds are connected to the Eberspächer turbocharger on this Volvo 9.6 litre engine

Below: Two axial flow fans are employed for cooling the Tatra V12 air-cooled engine; in each assembly is housed a dynamo. Both the fan assemblies and the air compressor are belt-driven







Above : Angular adjustment of the new Metalastik fuel pump coupling is made by slackening the locking bolt

Left: The M.I.R.A. test installation for measurement of the torques required to drive the fuel pump, valve gear and other auxiliaries

which has recently been introduced, was not on view, but is of the vertical, in-line layout and has direct fuel injection. The unit develops 170 b.h.p. at 1,900 r.p.m., and has a compression ratio of 16·5 : 1.

Sweden

Sweden, exhibiting for the first time at the Show, was represented by Volvo A.B. Direct injection, toroidal combustion chambers and wet cylinder liners in an integral cylinder block and crankcase are features of the Volvo engines, which are conventional six-cylinder, in-line, water-cooled designs with overhead valves. The 9·6 litre unit has a bore of 120·65 mm and a stroke of 140 mm, and its compression ratio is 17 : 1. It can be used in either the supercharged or normally aspirated forms. The normally aspirated unit delivers 150 b.h.p. at 2,200 r.p.m. with a torque of 428 lb-ft at 1,100 r.p.m. When fitted with the Eberspächer turbocharger, the engine develops 185 b.h.p. at 2,200 r.p.m., and the torque is 527 lb-ft at 1,400 r.p.m. The weight of the turbocharger unit, with its water-cooled bearing housing, is 66 lb. Two interchangeable cylinder heads are employed. They are equipped with Stellite-faced exhaust valves, with hard-chromium plated valve stems, and they have steel valve seat inserts.

Holland

Holland, also exhibiting for the first time, was represented by Van Doorne's Automobielfabriek N.V., generally abbreviated to DAF, of Eindhoven. DAF install oil engines of Leyland and Perkins design in their vehicles, but a DAF petrol engine is also available. The oil engines are the Perkins P6 unit, and the Leyland 0/350, six-cylinder, 5·76 litre engine, which is rated at 105 b.h.p. at 2,400 r.p.m. At present both are exported to Holland, but an agreement has been concluded between DAF and Leyland, whereby the 0·350 engine will be manufactured under licence in that country.

M.I.R.A.

The part played by the Motor Industry Research Association in providing basic information by undertaking carefully controlled experiments is illustrated by their demonstration of an engine rig for the investigation of the *lost horse power* of a diesel engine. There are several ways of measuring lost horse power. One is to measure the indicated and brake horse powers and to take the difference. The principal difficulty experienced with this method is the measurement of the indicated horse power sufficiently accurately. On the other hand, a disadvatage of the motoring method is that the various components that make up the total lost horse power vary according to whether the engine is developing power or is being motored. Extrapolation of the curve of fuel consumption plotted against b.h.p. provides only an approximate measure of the lost horse power. What is really required is an accurate measurement of the separate components, and the M.I.R.A. rig shows how an engine can be equipped with instruments to measure the power absorbed by the fuel injection and lubricating oil pumps, the camshaft and valve gear. Two special gear wheels, fitted with strain gauges, are introduced into the drive, so that the torque transmitted can be measured continuously under normal running conditions.

New coupling for fuel pumps

An interesting new type of coupling, for diesel engine fuel pumps and similar applications, has been developed by Metalastik Ltd. This design is based on the trailing link principle and has been developed to avoid the need for accurate fuel pump alignment. It has been thoroughly tested and has been found to be capable of accommodating $\pm \frac{1}{16}$ in parallel misalignment, 2 deg angular misalignment and $\pm \frac{1}{16}$ in end float. The maximum retardation in timing is less than $\frac{1}{4}$ deg and it is claimed that noise and wear are less than are obtained with more conventional couplings. So far, the tests have included over 3,000 hours running at 1,400 r.p.m. with maximum misalignment.

Metalastik have also developed a chain damper for fitting to the tension side of timing chains to prevent noise and wear due to excessive vibration. The damper is simply a steel shoe faced with a hard rubber compound, which bears directly on the chain.

Carburation and Induction

Thermostatically-Controlled Hot Spots Are by No Means Universally Accepted

THE incursion of diesel engines into the field of application for the spark ignition types has not maintained its original impetus, but nevertheless continues. The most recent step in that direction is the adaptation by the Rootes Group of a 2·26 litre four-cylinder diesel engine for commercial vehicle use, but in the main, the petrol units of smaller capacity still appear to be holding their own. A big factor in the resistance to the diesel challenge is the ready application of the petrol engines, produced in large quantities by the great motor car manufacturers, to commercial vehicles. The great majority of petrol engines are of the order of 800 to 2,300 cm^3 swept volume, but even those in the 4,000 cm^3 class can be adapted with little modification for commercial vehicle use. In the United States, similar trends are evident: manufacturers are installing the motor car power units, many of them V8 types, in their commercial vehicles. However, petrol is cheaper in America, so diesel engines are employed mostly in very heavy vehicles.

Since the previous Commercial Show there have not been any startling developments in fuel systems, either from the carburation or induction aspects, among the large numbers of petrol engine vehicles exhibited. As before, the design of carburettor overwhelmingly favoured for commercial work is the open-choke pattern. Most are downdraught units, but among the few exceptions are the new Morris J2 light van, equipped with B.M.C. 1,498 cm^3 four-cylinder engine incorporating a Solex horizontal carburettor. The decision to use this carburettor layout was doubtless dictated by the small space available in the close fitting internal bonnet.

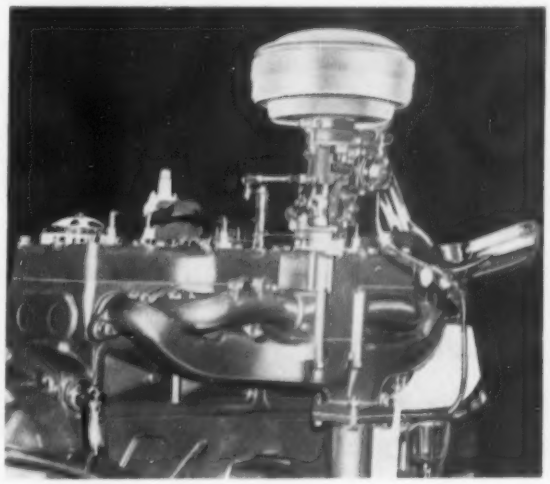
Owing to the continual trend towards the lowering of bonnet lines, existing designs of downdraught carburettors have for some years left much to be desired, so far as application to private cars is concerned. In the commercial vehicle field, the limitation of under-bonnet space has been nothing like so acute, but there are indications that difficulties with regard to this aspect of design are becoming more marked. This is because in many instances the engine compartment is now inside the cab instead of under a projecting bonnet of the older type. Since the space available in the cab is more limited, the problem of finding room for the carburettor and its air silencer attachments has become more serious.

The downdraught carburettor, despite its inconvenient requirements with regard to space, has retained its popularity. Carburettor designers are meeting vehicle manufacturers' requirements by designing very short downdraught units. One such example is the new Zenith 34-VN carburettor, fitted to the Bedford 10/12 cwt van, model CA.

Most of the open-choke carburettors of sizes greater than 30 mm throttle bore incorporate accelerator pumps and are equipped with automatic mixture controls giving lean cruising mixtures and enrichment for full power. Cold starting systems are mostly of the semi-automatic strangler type, with a fast idle linkage, but there are a number of Solex instruments equipped with the well-known Solex auxiliary starter carburettor. This device is built on to the main carburettor, and consists of a small rectangular chamber containing a disc valve and air and fuel passages. The disc valve can be partially rotated by means of the starter cable. In one position it opens ports to supply a mixture suitable for normal cold starting and in another position an even richer mixture for very cold weather.

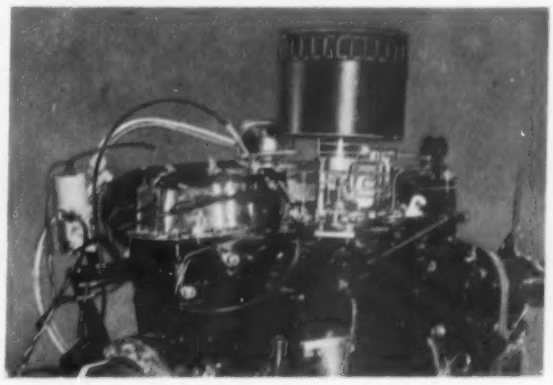
Induction systems are in the main similar to those employed on the private car versions of the engines, with the usual wide variety in form. On the four-cylinder units, the two port-branch tract, feeding siamesed inlet valve ports in the cylinder head, are the most popular, although there are a few four port-branch designs with separate inlet valve ports. With the six-cylinder power units, there is more variety, the designs ranging from the three port-branch tract, with three sets of siamesed inlet valve ports, to the four port-branch and the six port-branch layouts.

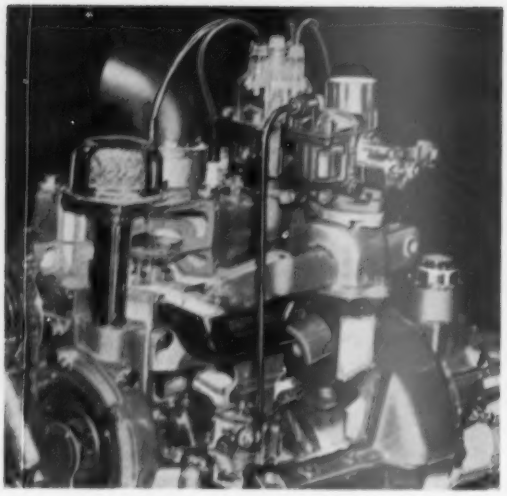
With the four port-branch design, cylinders 1 and 6 are usually fed by single branches of the induction tract, while cylinders 2 and 3, and 4 and 5 are siamesed in the cylinder head. In the six port-branch pattern, each inlet valve is in a separate port in the cylinder head. The induction manifold shape usually employed with this arrangement is known as the straight rake, each of the six port-branches leaving approximately at right angles to the main gallery. A similar scheme is generally employed on four-cylinder engines with



Above: Carburettor, and induction and exhaust manifold arrangement on the engine for the Standard van

Below: This Dodge installation is a representative example of a six-cylinder induction and exhaust system with a contact hot-spot





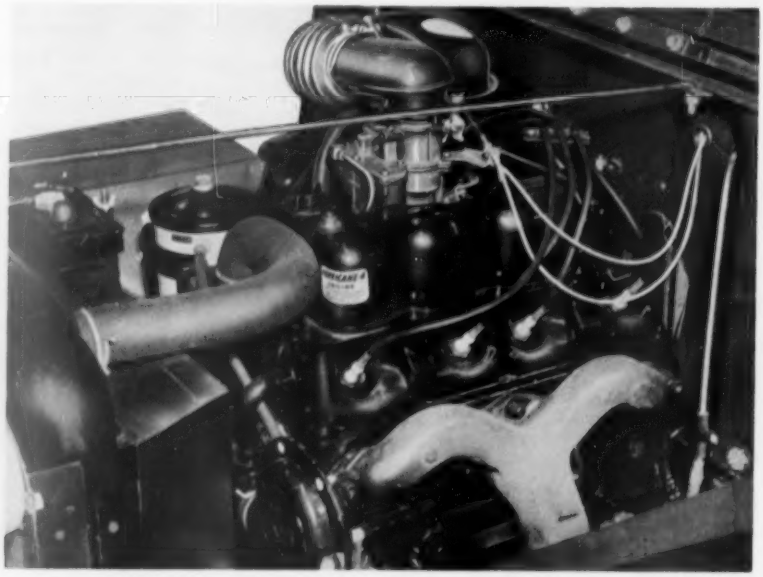
Left: An interesting feature of the carburettor and manifold arrangement of the Thames 7 cwt van is the slight inclination of the hot spot valve spindle. On the model exhibited, the carburettor and manifolds, as well as other parts of the engine, were sectioned. Right: The carburettor and induction system, with its heat-insulating shield and air cleaner, on the Commer express delivery van

four port-branch systems, but with all other arrangements there is a great deal of variety in the layout of the port-branches relative to the induction gallery. In some instances, the gallery is turned sharply into the port branches, and in others it sweeps gently inwards to the cylinder head valve ports. Cross sectional shapes also show a great deal of variation in thought, some are rectangular, others round, while some are D-shaped, with the flat portion of the D-section as the base.

Generally, hot spots are of the exhaust-heated pattern, but one of the exceptions to this rule is the Land-Rover, on which the induction system is coolant-heated. Exhaust-heating is the more easily arranged of these two types and the most popular arrangement is to have both the manifolds on the same side of the engine; in most instances, the induction manifold is above that of the exhaust, the two being bolted together in the middle, just below the junction of the riser T and the induction gallery.

On the British vehicles there appears to be a movement away from the thermostatically-controlled hot spot valve, a device which has been extremely popular for many years on American vehicles. This scheme, of course, incorporates a flap valve, off-set mounted just below the junction of the exhaust manifold branches and the down-pipe section of the casting. This valve is arranged so that in one position it directs exhaust gases upwards through a chamber, or jacket, enclosing the induction riser T-junction. The heat valve is controlled by a coiled, bi-metal thermostat spring, the inner end of which is attached to the heat valve spindle and the outer end to the manifold casting.

Possibly the decline in the popularity of this system is due to the fact that spindles have been known to stick and lock the valve in one position. If they are fitted more loosely in their bearings, they may rattle when the vehicle is in motion. Thermostatic controls are employed on the Ford Thames 5 and 7 cwt vans, and also on the new Commer express



An F-head is employed in the Willys engine for the Jeep, and the induction tract is cast in the cylinder head

delivery van. An interesting feature of the Thames engine arrangement is the fact that the spindle of the thermostatically-controlled flap valve is at a slight angle to the horizontal plane, possibly to prevent any tendency to rattle.

A newcomer to the commercial vehicle field is the power unit installed in the Commer express delivery van. This is an overhead valve, four-cylinder engine of 1,390 cm³, similar to that employed in the Hillman Minx private car. It replaces the Commer side valve unit previously used. Whereas the side valve induction system consisted of a two port-branch casting, feeding siamesed inlet valve ports in the cylinder block, the overhead valve unit has a four port-branch induction system, each port serving its individual inlet valve. Above the four port-branch exhaust manifold, on the left-hand side of the engine, the cast iron induction manifold is of the straight rake form, the four port-branches being at right angles to the gallery tract. In cross section, the main gallery is semi-circular. It changes to a rectangular section at the port-branches, the inlet valve ports also being of rectangular cross section.

A thermostatically-controlled hot-spot is employed, the riser junction with the gallery being jacketed. When the engine is cold, the heat flap valve below directs the exhaust gases through the jacket. This heat valve is of conventional pattern, being of sheet steel mounted on a spindle carried in the vertical portion of the exhaust manifold, at a level just below where the main exhaust gallery merges into the vertical part of the casting. The spindle is parallel with the engine crankshaft, and the coiled bi-metal thermostat spring is fitted to its rear end. A pin anchors the outer end of the spring to the manifold casting. Attached to the front end of the valve spindle is a bob-weight. When the valve is open, that is, in the hot position, the bob weight rests on a pad on a small bracket secured to a stud on the manifold. A drain tube is fitted to the induction manifold, at a point underneath the riser.

Mixture is supplied by a Zenith 30-VI carburettor, which is a simple static instrument with neither an accelerator pump nor an economizer. This carburettor effectively satisfies the requirements of the engine. Cold starting is controlled by an offset-mounted strangler valve linked to a fast idle system by means of which the throttle valve is opened a pre-determined amount when the strangler valve is fully closed. An A.C. air silencer of the F.P. pattern is mounted above the rocker cover, the intake extension fitting directly to the carburettor intake. Fuel is supplied by an A.C. mechanical pump on the right-hand side of the crankcase. A good feature of the installation is the reinforced heat-shield, which fits under the carburettor flange and shields the float chamber from radiation from the exhaust system below.

The four-cylinder engine of the Willys Jeep, with overhead inlet and side exhaust valves, has a swept volume of 2,180 cm³. Its induction system is on the left-hand side, and the tract is cast within the cylinder head. A bulge on the outside of the head contains the induction riser and is the only portion of the induction system visible from the exterior. Mounted on the riser is a Carter downdraught carburettor, with its air intake connected to a large cylindrical air cleaner, attached vertically to the engine bulkhead. The connection is made by means of a length of corrugated hose and a fabricated metal elbow, which fits over the carburettor. Fuel is supplied by a mechanical pump on the left-hand side of the crankcase.

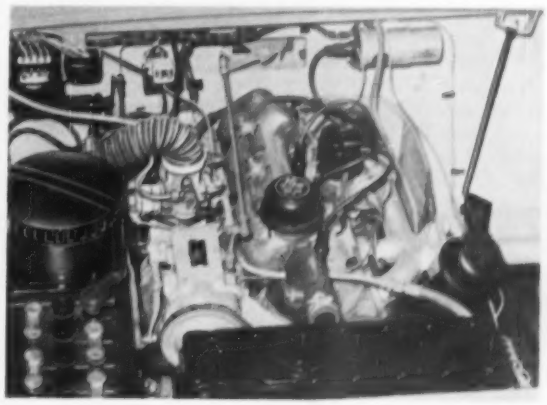
Extra heat for the mixture is unnecessary, since the tract is heated by the engine coolant in the head. With this valve layout, heating by means of coolant is necessary in any case, because the exhaust ports must be on the opposite side of the engine from those of the inlet valves. Thus, in this unit, the exhaust system is on the right-hand side of the engine, the exhaust manifold being of the four port-branch pattern. The off-take for the down-pipe is connected to the centre, in the usual manner. Unlike many American vehicles, this model has not an automatic choke. Cold starting is effected by means of a conventional hand-strangler, the flap valve of which is mounted offset relative to the axis of its spindle. The strangler is linked to a fast idle system to provide automatic throttle opening when it is closed.

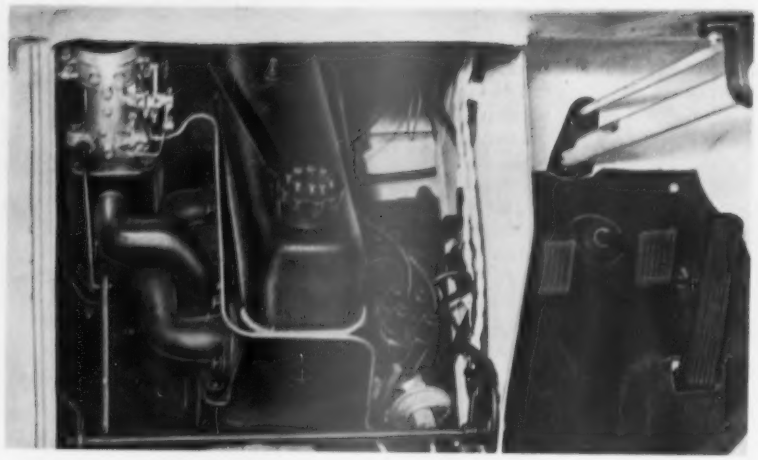
The coolant-heated hot spot on the Land-Rover remains in the main unchanged. A four port-branch aluminium induction manifold has a jacket surrounding the junction between the riser and gallery, and hot coolant is circulated through this jacket. Like the engine described in the last paragraph, this unit has overhead inlet and side exhaust valves. The induction manifold is of circular cross section and is of the straight rake form, except in that the port branches spread outwards towards the cylinder head, their axes being closer together at the manifold than at the cylinder head. A Solex downdraught carburettor is employed, and the fuel supply is effected by an S.U. electric pump. This is one of the few vehicles so equipped, the great majority having fuel pumps of the mechanical variety.

Rolls-Royce Ltd. also exhibited engines with coolant-heated induction systems, and here again the overhead inlet and side exhaust valve arrangement dictated the positioning of the exhaust manifold on the side remote from that of the induction. The six- and eight-cylinder in-line models are interesting examples of dual carburation. In each instance, a large dual downdraught, Solex carburettor is fitted. This carburettor is one designed specially to meet Ministry of Supply requirements: it incorporates, among other items, a manual control for variation of mixture with altitude. On the six-cylinder model, one barrel of the carburettor feeds the front three cylinders and the other barrel the rear three. On the straight-eight version, a conventional induction porting layout has been adopted. The outer barrel of the dual carburettor supplies mixture to cylinders 1 and 2, and to 7 and 8, while the inner barrel serves cylinders 3 and 4, and 5 and 6. Aluminium induction manifolds are employed, and the gallery tracts are of rectangular cross section.

In contrast with the examples of induction arrangement already described, the Bedford 10/12 cwt van has a four-cylinder overhead valve engine with an induction system of the two port-branch layout, the branches feeding siamesed inlet valve ports. Two iron castings form the induction and exhaust manifolds, which are both on the left-hand side of the cylinder head. The induction manifold is above that of the exhaust. A deep riser is employed, and the two

Carburation system on the Land-Rover. The S.U. electric fuel pump is fitted on the right-hand side of the engine bulkhead





The new Zenith 36 VN, short downdraught carburettor on the Bedford 10/12 cwt van, which has its bonnet inside the cab

galleries drop sharply downwards from it and then turn inwards to the cylinder head ports. Following established Bedford practice, the cross section of the induction tract is of D-shape, the flat forming a floor of relatively large area to facilitate evaporation of liquid fuel.

Another feature of this Bedford unit is the thermostatically-controlled hot spot. The riser T-junction is jacketed, and when the engine is cold, a flap valve in the exhaust manifold casting below directs the exhaust gases through this jacket. A conventional arrangement has been adopted, the coiled bi-metal thermostat spring being attached to the rear end of the flap valve spindle, and a bob weight is mounted on the front end.

An interesting feature of this installation is the new Zenith 34-VN carburettor, which is one of the extra-short downdraught models produced to meet vehicle manufacturers' requirements in respect of decreasing under-bonnet space above the engine. This carburettor is similar in general design to the existing V series, but incorporates several new features. These include a change in the design of the emulsion system to provide better hot starting when ambient temperatures are very high: the emulsion block is now inside the float chamber instead of outside. The accelerating pump incorporates a device for prolonging the pump discharge, and an ingenious feature provides for ready adjustment to the pump stroke to suit either summer or winter conditions.

Automatic mixture control for economical cruising is obtained by the familiar variable air bleed system employed for many years in Zenith carburettors. This takes the form of a flexible diaphragm, subject to engine depression and held in the downward position by means of a spring. The under-side of the diaphragm carries a plate valve which, at full throttle, when engine depression is low and a maximum power mixture is required, seals the large air bleed orifice. At part-throttle, when leaner mixtures can be used, the increased engine depression lifts the diaphragm against its spring and thus opens the larger air bleed orifice. This admits more air into the emulsion system and weakens the mixture. For cold starting, a conventional offset-mounted strangler valve is employed, with a linked fast idle system. An air silencer of the T-type is mounted directly on the air intake of the carburettor. Fuel is supplied by an A.C. mechanical pump on the right-hand side of the crankcase.

Transmissions

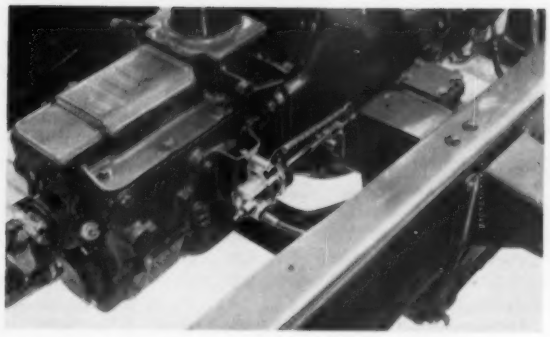
Continued Trends Towards Greater Utility and Simpler Controls

IT cannot be said that there have been many changes in commercial vehicle transmissions since they were reviewed in *Automobile Engineer* two years ago. In general, the latest trends can be classified in two main categories: greater utility, and simpler controls. Those in the first category give advantages by way of improved fuel consumption, capacity for heavier payloads or, in the case of passenger service vehicles, greater accommodation, effective tractive effort under the worst possible conditions and facilities for the use of power for purposes other than vehicle propulsion. Those in the latter category give comparable advantages by way of improved performance generally, reduced wear, lower maintenance costs, improved comfort and road safety. Improvements in both categories tend to enhance appearance. Such advances that have been made are not confined to gearboxes but are to be found on all transmission units ranging from the clutch to the driving axle or axles.

Clutches

With regard to the operation of the friction type clutches, there is a marked increase in the number of designs incorporating hydraulic actuation. Centrifugal engagement arrangements are gaining in popularity, and a new application by Newton and Bennett Ltd., combines electric and vacuum control with centrifugal engagement.

Hydraulic actuation, does not, as some believe, give easier gear changing or any appreciable reduction of driver fatigue. It is incorporated to dispense with complicated linkage, and it is particularly useful where the clutch pedal is remote from the lever on the withdrawal shaft. With



View showing the arrangement of the hydraulic actuation of the clutch on the Dodge truck, equipped for left-hand drive

this type of actuation, the employment of either a frame- or a body-mounted pedal presents fewer problems particularly when the engine is flexibly mounted. Further, the arrangement is easier to accommodate in the limited space available in most bodies. Beardmore, Dodge, Guy, Jenson and Seddon chassis are among those incorporating hydraulic actuation.

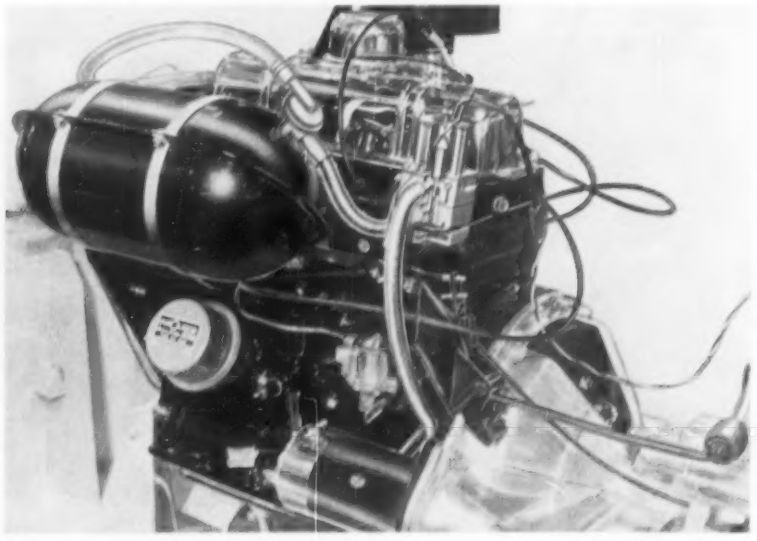
The Unipower Hannibal timber tractor, made by Universal Power Drives Ltd., continues to employ a clutch with centrifugal engagement. Also of interest in the heavy vehicle field is the centrifugal clutch offered by Leyland Motors Ltd., as an alternative to a fluid flywheel used in conjunction with a Wilson type gearbox on their new Atlantean passenger service vehicle. This clutch is of Leyland design and is of the single dry plate type. Its six, radially disposed, bob-weights act in the usual manner through bell-crank levers, to apply force to the pressure plate. When the clutch is fully engaged, the bob-weights abut against a stop-ring, to relieve the mechanism of undue stress. The four-stage positive adjustment is similar to that employed on all Leyland clutches.

Among the light vehicles, one of the surprises at the Show was the Standard 6 cwt delivery van equipped with the Standrive two-pedal control. This control incorporates Newton and Bennett patents, and, like the Manumatic system introduced a few years previously by Automotive Products Co. Ltd., has basically a centrifugal clutch with a combined vacuum and electrical control. The electrical control of the Standrive equipment consists simply of a switch incorporated in the knob of the gear lever, and an electro-magnet for air-vacuum valve operation. An equally simple vacuum system is employed. It consists of a vacuum tank connected to the induction manifold, the air-vacuum valve previously referred to, and a clutch withdrawal servo. Both the electro-magnet and air-vacuum valve are combined to form a single unit which, together with the tank, can be installed in any convenient position near the servo. The combination of these components allows gear changes to be made simply by moving the gear lever: all that is necessary when making a gear change is to press the button on the top of the gear lever, which can then be moved in the normal manner.

Of greater interest, is a feature relating to the clutch itself. Hitherto, two sets of springs have been employed in centrifugal clutches of the type capable of being withdrawn whilst the engine is running above their critical speed. These, of course, are the pull-off springs and the driving springs. In the Newton clutch, however, only one set of springs is used for both purposes. This is accomplished by the employment of bob-weight levers of a simple and ingenious design. Each lever has two fulcrum points: one is the usual fixed pivot on the clutch case; the other, for disengagement of the clutch, is a thick washer, backed by a stud nut, against which bears a cam formed on the lever. Each stud, of course, passes freely through an eye in the main portion of its lever arm. This arrangement enables the mass of the weights to be reduced substantially, resulting in a corresponding reduction of stresses. Moreover, the cam is shaped so that allowance for wear of the driven plate is made automatically; thus adjustment is not required during the life of the linings.

Although, so far, this clutch has appeared only as a 6in diameter unit on the Standard vehicles, everything is ready for full-scale production of the 7¼in, 8in and 9¼in sizes. A 15in diameter version, which is to be introduced soon, has been tested over an extensive period, during which only minor adjustments were necessary.

Another surprise at the Show was the announcement that on certain types of B.M.C. vehicle, such as the Morris-Commercial J2 van, the Manumatic transmission system is now included as optional equipment. Although for commercial vehicles, the friction clutch continues to be most popular the fluid flywheel is becoming widely favoured for



The power and transmission units of the Standard 6 cwt van, showing the relative sizes of the units comprising the Standrive equipment. The largest component is the black vacuum tank; others that can be seen are the sectioned air-vacuum valve and a portion of one of the bob-weight bell cranks

Controls of the Standard 6 cwt van, with the button switch on the knob of the gear lever and a two-pedal arrangement on the toeboard

public service vehicles because it lowers maintenance costs and tends to reduce driver fatigue.

On the Leyland Atlantean, the gearbox is of the Pneumo-Cyclic controlled, Wilson type. It is installed, together with the engine, at the rear of the vehicle. Because of this, a gear change control unit of C.A.V. design and manufacture has been substituted for the more usual air-pressure distribution valve arrangement.

The new C.A.V. control is also employed in the Monocontrol in the A.E.C. vehicles. It consists of two units. One is an electro-pneumatic valve block near the gearbox, and the other is a controlling selector switch operated by a small lever conveniently near the driver's hand. The valve block comprises a bank of five double-valves. Each pair of valves, when actuated by the plunger of a solenoid, diverts compressed air from a common inlet gallery to one of five outlets each of which is connected to one of the five change mechanisms of the four forward and one reverse gears. Release of the solenoid plunger permits the valve to return, under the action of a spring, to a position where it simultaneously seals off the inlet gallery and exhausts the compressed air from the disengaged gear to a common outlet gallery.

The gear selector switch consists of a set of five pairs of electrical contacts mounted on leaf springs and opened and closed as required by a cam mounted on a sliding spindle. The cam is operated by a lever, virtually the gear lever, connected to one end of the spindle and protruding through a gate in the top of the light alloy switch housing. Movement of the lever into any slot of the gate causes a similar movement of the cam which, in turn, closes the corresponding pair of contacts and energizes the appropriate solenoid in the valve block.

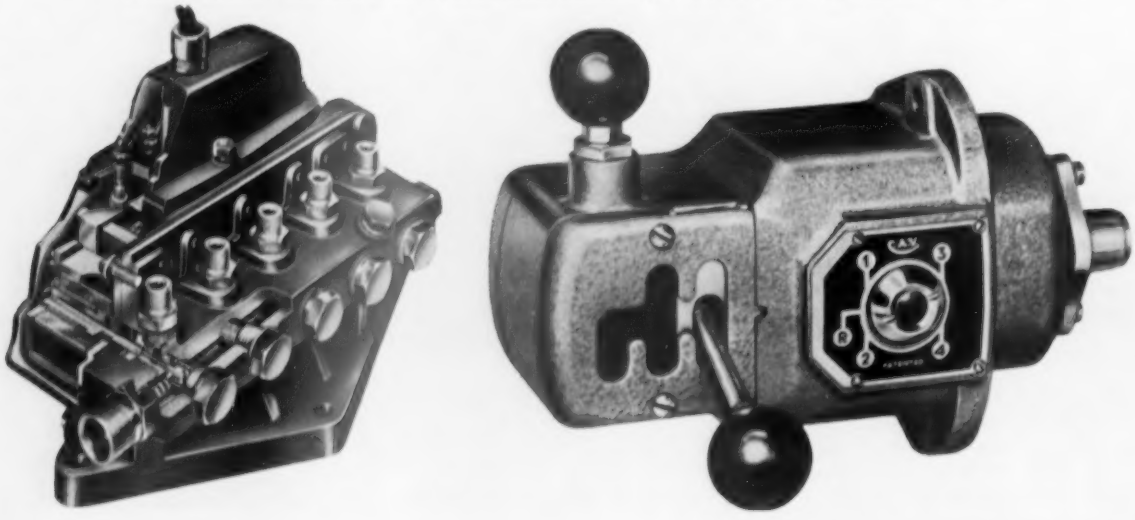
A metal label, reversible to suit right- and left-hand drive installations, identifies the gate positions, and a red light, operated by another set of contacts, glows when the lever is in neutral, thereby indicating that an electrical supply is available at the switch.

In passing it may be of interest to note the development of the controls for diesel railcars equipped with Pneumo-Cyclic gearboxes. The controls for railcars made by British United Traction Ltd. are designed by Self-Changing Gears Ltd. They follow, to a large extent, the general layout of the controls of an electric train, in that they have a forward speed lever with a " dead-man " handle, and a reverse lever with an adjacent speed control. The forward speed lever is on the left of the driver and operates a bank of cams by which contacts are closed successively for the energization of electro-pneumatic valves, somewhat after the manner of the C.A.V. unit. The reverse lever is on the right-hand side of the driver and serves as a master switch governing both directions, the adjacent speed lever serving to introduce, by means of a cam, reverse gear. On the right of the reverse lever and positioned vertically on a rocker is a small lever. Working through a valve system, this shifts one or more axle driving pinions into appropriate engagement for unidirectional axle rotation. This arrangement is essential, first because there are two or more power units per car, in positions where their driving ends face one another, and secondly because the car can be driven from either end. A bank of warning lights extends in front of the lever. They indicate whether or not all power units are engaged correctly. To guard against failure of these warning lights, a duplicate set is arranged above the driver. A brake control and a set of instruments complete the installation.

Gearboxes

Except for vehicles equipped with semi-automatic or fully automatic transmission, such as the Pneumo-Cyclic unit, there were few steering-column-mounted controls.

C.A.V. gear change control units for pneumatically-operated gearboxes, such as the A.E.C. Monocontrol arrangement and the system fitted to the Leyland Atlantean. Illustrated on the left is the electro-pneumatic valve unit and on the right is the selector switch



Notable among the exhibits employing a conventional four-speed box and steering column control was the Beardmore taxicab chassis. All types of box were to be seen, ranging from the straight-tooth sliding gear type on Reliant three-wheeled vehicles to the Rolls-Royce heavy-duty fully automatic gearbox and the synchromesh multi-way transfer box of the latest Dennis F24 fire engine.

Of the vehicles with a synchromesh or a constant mesh box, only a few had three speeds, the minimum for most of the lighter vehicles being four. For the heavier vehicles employing one or other of these types of box there were, of course, four, five or six speeds which, in many cases, were supplemented by an overdrive or auxilliary box. The overdrive, incidentally, is increasing in popularity, due no doubt not only to the improved performance and fuel consumption it gives, but also to the ample space for its accommodation on a heavy vehicle. Among the makes of vehicle so fitted are the A.E.C., Commer, Guy, Maudslay and Volvo. In many cases the overdrive is built into the gearbox and brought into action by the gear lever, as for example on the latest version of the A.E.C. Mammoth Major VIII.

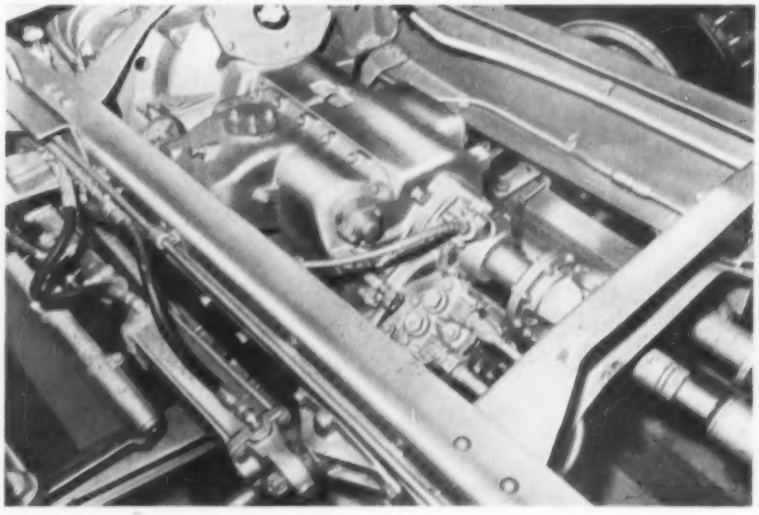
Auxilliary boxes continue to be fitted on heavy, special or multi-purpose vehicles. Their use on ordinary vehicles, however, has suffered some decline in preference for a five-speed box with built-in overdrive. Mention, too, must be made of the fact that the Fuller gearbox, an American product supplied to, and possibly soon to be produced, for the European market, by Automotive Products Co. Ltd., has a five-speed main box and a two-speed auxiliary box in one unit, so as to provide eight forward and two reverse speeds. There is only one power shift between speed ranges during the entire shifting cycle through all forward speeds, this being accomplished simply by moving a selector handle which is placed conveniently on the gear lever. An air system effects the actual gear shifting of the auxiliary section, the main section being manual. All manual shifts, up and down, are made in the conventional manner. The Fuller gearbox is available in three models, one of which has overdrive. They are known as Fuller Semi-Automatic Road Ranger units.

The position of power take-off is almost unchanged. For the Land-Rover an additional take-off is available as an optional extra.

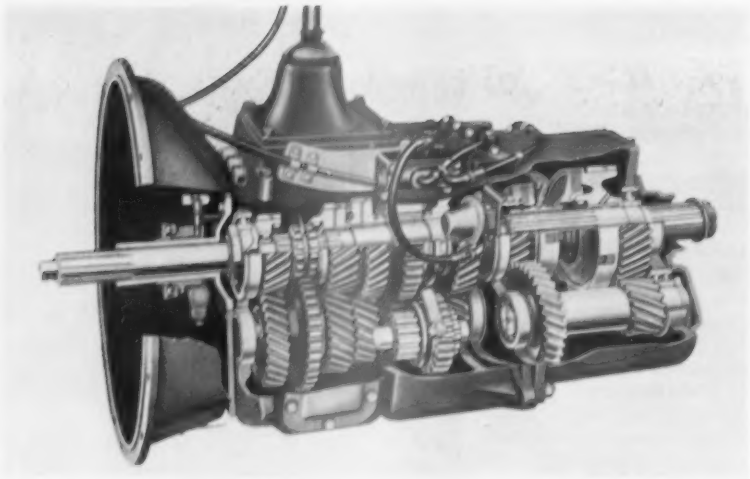
So far, semi-automatic or fully automatic epicyclic transmissions have, on British vehicles, been confined to buses

Above: A.E.C. Monocontrol layout, showing the new C.A.V. selector switch to the left of the steering column. The absence of a clutch pedal simplifies the arrangemint of the toeboard

Below: The controls of the British United Traction diesel railcar. On the left is the "dead-man" handle for the forward speeds. To the right of this control are the reverse levers, and on the extreme right is the axle driving pinion shift lever



This example of a built-in overdrive is on the A.E.C. Mammoth Major VIII. The overdrive is housed in the end cover of the gearbox and is brought into operation by a selector rod; there is a link connection between the rearward extension of the rod and the overdrive engagement lever



Fuller, model R.46 Road Ranger semi-automatic gearbox with an air shift control arrangement giving eight forward speeds and two reverse

The epicyclic gear of the Hobbs P.S.V. type automatic transmission

and coaches. Design, too, has remained much the same, developments, other than the modes of control mentioned being largely in the direction of additional gear ranges. For example, on the Foden FG 8/24, an eight-wheeler for export, there is an epicyclic box with twelve speeds, coupled to a heavy-duty clutch.

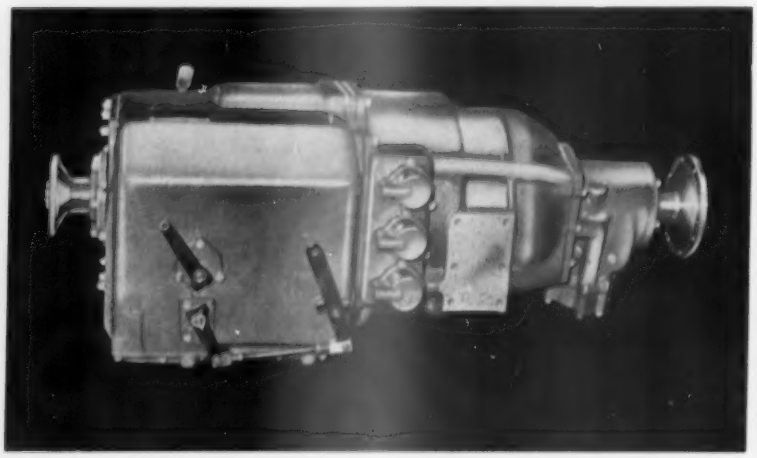
Also of interest in the epicyclic field is an addition to the Hobbs range of automatic power-shift transmissions. It is suitable for amidship mounting in passenger service vehicles.

The Rolls-Royce automatic transmission is a three-stage torque converter, made under licence from the Twin Disc Co. of America. It operates on the well-known hydro-dynamic principle, and is of a type which for some time has been fitted to crawler tractors, shunting locomotives and diesel railcars, and, as mentioned before, is now standard equipment on the Dennis F24 fire engine. Only the Series 10,000 torque converter was exhibited, but the Series 11,500 and 13,800, which vary in diameter of the impeller, for different power ratings, will also be manufactured to match Rolls-Royce oil engines in various applications.

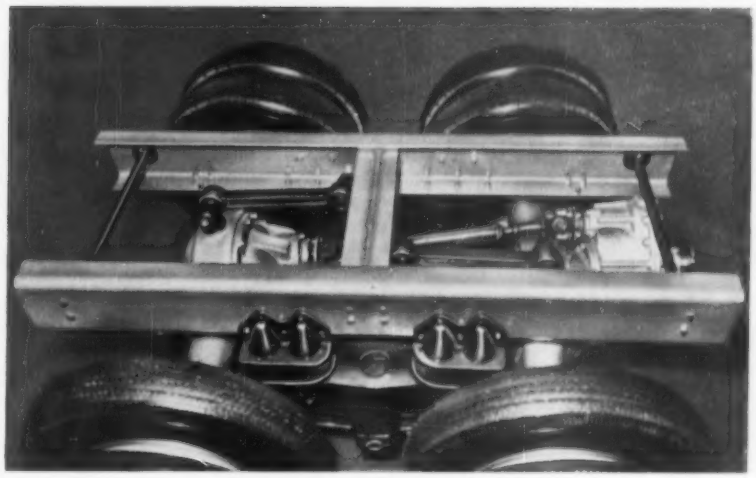
Propellor shafts and final drives

Two exhibits marking an advance in the layout of the propellor shaft on double-decker buses so as to obtain a low floor and reduce overall height were the Crossley Bridgemaster and the Leyland Atlantean. At the rear of the gearbox of the Bridgemaster is a transfer box, which provides an offset drive to the rear axle. The gears are of the single helical type, with a ratio of 1 : 1. From the transfer box the drive is taken through a three-piece propellor shaft, with Hardy Spicer needle roller universal joints, to the axle. This is of the double-reduction, spiral bevel and spur gear type, and attached to a pair of arms by inclined rubber mountings. These arms are pivoted to the body underframe at the front ends and bolted to a cross-member at the rear, which reacts against coil springs. Self-aligning bearings supporting the centre section of the propellor shaft complete the assembly.

A double-reduction, spiral and helical gear axle is employed on the Atlantean, but here the axle is underslung on leaf springs and its offset drive is taken from the rear. This rear



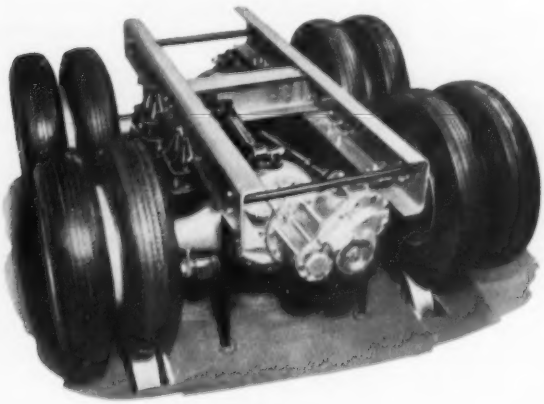
This exhibit is the Hobbs automatic transmission unit for public service vehicles. It is of the self-contained type, designed for mounting separately in the chassis and is suitable for engines delivering as much as 450 lb-ft torque



Below and on the right are two views of the Eaton 32M tandem drive axle layout fitted with the RS320 all-rubber suspension. The power divider is on the front of the forward axle, and stabilizer rods connect both axles to a frame cross-member

drive is by a short propellor shaft, which has a needle roller universal joint at each end. The shaft is driven from an angle drive at the rear of the gearbox, which, together with the engine, is mounted transversely at the rear of the vehicle.

Generally speaking, the open propellor shaft is almost universal on commercial and passenger service vehicles. Of the exceptions, the Tatra design is worthy of mention because, although by no means new, its application to heavy commercial vehicles was seen at Earls Court for the first time since the war. The chief feature of the design is a centrally-disposed tubular member which serves to house all transmission units and forms the backbone, as it were, of the vehicle by taking the place of the conventional frame.

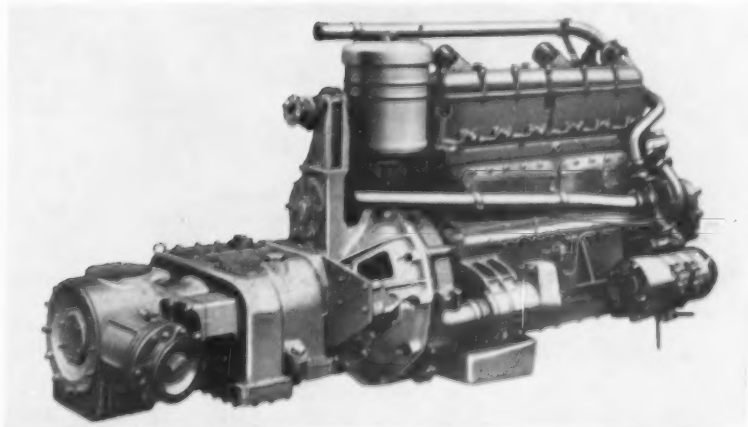


Two-speed axles, especially the electrically-engaged Eaton type, are increasing in popularity. They were to be found on many British and foreign vehicles.

The most intriguing development in this field, however, is the Eaton 32M tandem-drive axles with power divider, inter-axle differential lock-out and RS320 all-rubber suspension. For normal operating conditions the power divider, virtually a third differential, equally divides the power between the two axles, when surface conditions are unfavourable. The differential lock-out enables the driver temporarily to lock out the differential action between the two axles, so as to obtain the maximum traction.

The power divider assembly is mounted on the front of the forward differential carrier and includes the spiral bevel drive pinion. It is, therefore, removable from the differential carrier as a unit, or from the axle housing as a combined unit with the axle differential.

A sliding clutch gear constitutes the differential lock-out. It is mounted on the input shaft of the power divider, and is held in the disengaged position by a spring-loaded selector fork. The unit is supplied as an optional extra.



An interesting feature of the Leyland Atlantean transmission layout is the angle of the final drive behind the gearbox

Suspension

Review of New Systems for Passenger-Carrying Vehicles

DEVELOPMENTS in heavy-vehicle suspension systems are now moving forward at increasing pace. In this field the private car has been subject to such far-reaching changes during the past twelve or fifteen years that, by contrast, justification might have been advanced, until recently, for the belief that public service vehicle designers were taking no great interest in the adoption of new types of springing and in the exploitation of non-traditional suspension layouts in general.

For some years now the motor car, including even the low-priced popular types, has been equipped with independent front-wheel suspension, an arrangement with which the use of either coil or torsion bar springs is favoured. Rear suspension, however, has remained preponderantly conventional, with semi-elliptic laminated springs in conjunction with a rigid beam axle. There are, of course, many motor cars of advance design in which independent rear springing of the swing axle type is incorporated, while a partial step in the same direction is to be seen in certain revivals of the De Dion type of rear axle. Both arrangements favour the employment of coil spings.

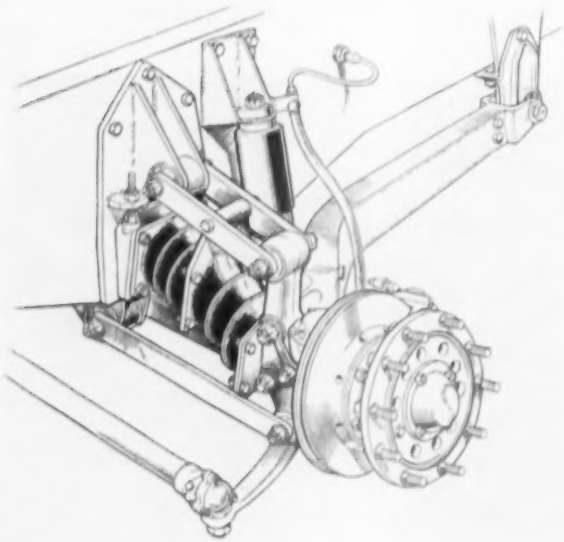
In the case of private cars, of course, increasing engine performance has produced road speeds that call for exceptional road-holding characteristics and maximum directional stability during high rates of deceleration, and so on. Differences in loading between the full and empty condition, and the influence of weight transference during braking as compared with the static weight distribution associated with the modern and extreme forward engine mounting, have all had their influence upon the ultimate characteristics of independent front suspension.

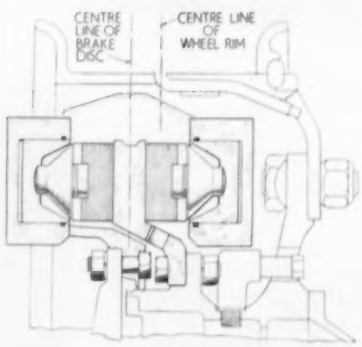
With public service vehicles, increase of speed has not been quite so spectacular because of the arbitrary legal limitations which apply in this country. At the same time it must not be overlooked that British buses and coaches are not only exported to many countries where no similar speed restrictions exist, but they are also operated on continental runs by British touring organizations; they must, therefore, be capable of a higher performance than is customarily expected at home.

With the accepted type of British coach or bus, however, home influence has not produced any urgent demand for the easier-riding characteristics associated with modern springing systems. Component layout likewise has not so emphatically forced independent front suspension on the bus designer as has forward engine mounting and low build in the sphere of the private car. After all, the sump depth of the normal forward-mounted bus engine can be so modified as still to leave ample clearance for the maximum rise of the ordinary front axle beam.

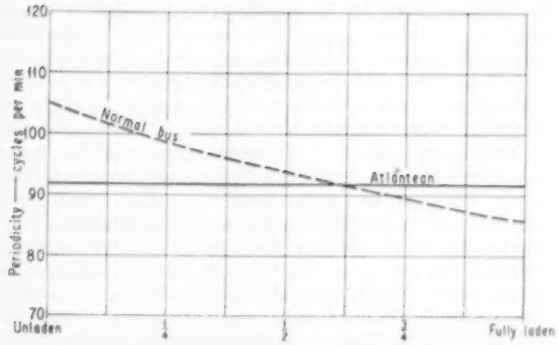
With the advent of the underfloor-engined single-decker of large seating capacity, an entrance forward of the front axle has become usual. General floor level in relation to the ground is determined by the height of the uppermost engine parts, and this dimension in turn is fixed by the necessary ground clearance allowance beneath its lowest point, which is a far more inflexible requirement than the space that must be left above the front axle. Nevertheless, an independent front suspension system favours the provision of a low-level single-step front entrance and an unobstructed central gangway, so that it is patently advantageous to the planning of a front-entrance vehicle. It can be nullified, however, by the central underfloor location of the engine or, more correctly, it may be said that the benefits which it offers cannot be fully exploited.

Some tentative moves have certainly been made in the past towards independent front springing. But not until the low-level bus becomes an established fact can rapid progress and universal adoption be expected. The new A.E.C., Leyland and Dennis designs point the way. The freedom from the need to provide clearance for axle movement under the forward end of the gangway, which is a feature of the wishbone type of stub axle articulation, and the avoidance of major components under the inter-axle floor area





In the Metalastik front suspension layout used in the B.M.M.O. bus, a rubber spring, loaded in compression and shear, is employed. The unit has an intermediate steady-plate, anchored to the centre of the upper transverse link, to prevent the spring from bending or buckling. The sectional illustration above is of the disc brake installation used in conjunction with this suspension system



It is generally agreed that a pediodicity of approximately 90 oscillations per minute is the most acceptable from the point of view of comfort. This rate is maintained throughout the load range on the Leyland Atlantean, whereas the same manufacturer's Titan model, of course, has a suspension of a more conventional design

combine to make possible the overall low level, together with stepless entrances at front or rear, according to engine location.

In the case of a double-decker with normal forward engine, the i.f.s. system makes possible a considerable lowering of engine height, but the full advantage of the resulting lower build and floor level is still dependent on a correspondingly low rear-entrance platform and stepless saloon entrance, which in turn demands the incorporation of some form of dropped rear axle. This approach was pioneered by the Bristol Lodekka, now carried on as the Dennis Loline, and confirmed in the latest A.E.C. design. In this, i.f.s. contributes to a low engine which remains in the traditional forward position, while a dropped double-reduction rear axle provides for a low-level centre gangway free from obstructions in the region of the differential pot. the underslung trailing-link coil-spring suspension system at the rear is also an important factor in producing this result.

Where the normal rigid-beam front axle is still used, as it is on practically all existing front-engined rear-entrance double-deckers, the accepted springing is of the semi-elliptic laminated type, often (but not universally) controlled by telescopic hydraulic dampers. It is usual to incorporate rubber buffers or bump pads which are so positioned and dimensioned as to supplement the spring action under extreme deflections. Such devices form an elementary type of two-rate suspension system and they might well be elaborated by the incorporation of bonded and prestressed rubber-bushed linkages.

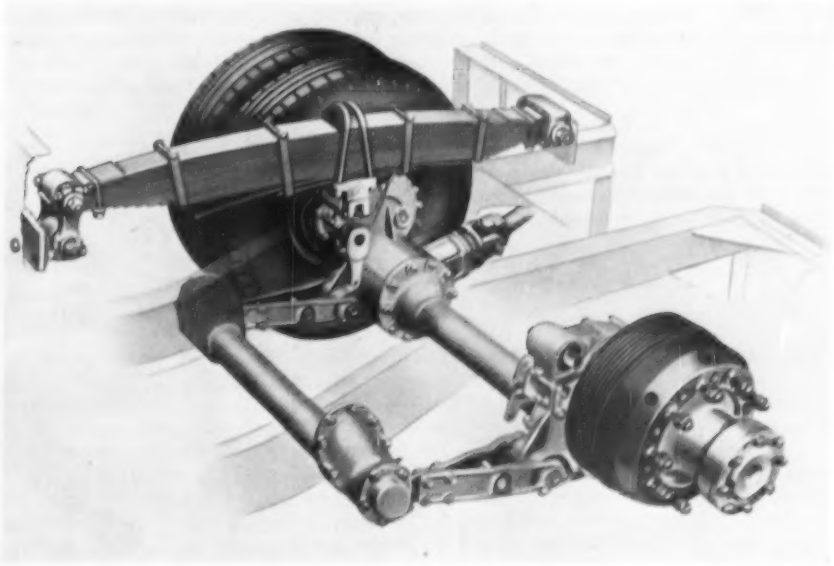
Of the modern independent front suspensions that have been developed, the pioneer is the B.M.M.O. type in which Metalstik rubber springing is used. This has a wishbone arrangement in which rubber springs in both compression and shear are employed. The wishbones and their brackets are reinforced by fore and aft arms to cope with brake torque.

Then, some two years ago, there appeared the London Transport-A.E.C.-Park Royal Routemaster bus, the low build of which was based on an unusual suspension system that embodies a coil-spring i.f.s. wishbone layout as well as coil rear springs. Both features have been embodied in the still more recently introduced A.E.C.-Crossley Bridgemaster which, as the name implies, is of low overall height while retaining the normal headroom in both the upper and lower saloons.

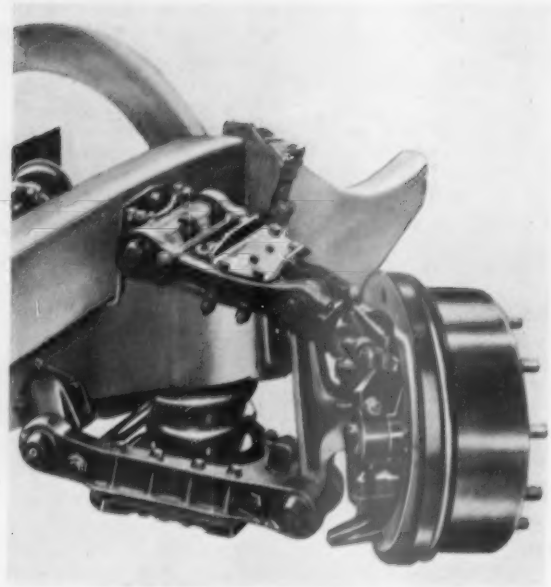
Yet another example of the inevitable trend towards independent front suspension is seen in the latest Leyland front-entrance, low-floor double-decker, the Atlantean. Here the suspension is provided by torsion bars which are, in effect, the rearwardly extended pivots of the inboard ends of the lower wishbones. These are carried in rubber bushes housed in the fabricated steel-plate beam incorporated in the frame.

The B.M.M.O.-Metalastik system employs rubber for the primary springing. In other systems depending upon either coil springs or torsion bars the use of bonded-rubber bushes not only reduces the need for lubrication servicing but also supplements the spring action to a marked degree. Where coil springs are used it is a convenient and usual arrangement to place telescopic hydraulic dampers within the springs or alternatively to fit rubber buffers inside them to provide a two-rate suspension system responsive to the smaller oscillations yet resistant to severe impact deflections. Owing to shortness of the wishbones the angular movement on the rubber bushes may become excessive, so that wheel rise must in some case be restricted.

Rear springing is retained largely in its normal form of inverted semi-elliptics, sometimes with rubber-bushed shackles, but more often having metal-bushed shackle pins which require lubrication. Rubber bushes are rather bulky and



On the Leyland Atlantean rear suspension, supplementary leaves, of extra camber, act on the helper principle to give a progressive rate. The effect of the rubber bushes of the shackle pins, as well as the radius links, has also been taken into account



Short wishbones can limit the range of wheel deflection

are frequently more costly than the metal type. Nevertheless it is not these factors alone that have discouraged their wider adoption. To offset cost, for example, is their undoubted accompanying advantage of reduced servicing time, while their size is no particular handicap. The chief drawback is that the unwanted axial flexibility might accentuate the side movement of the chassis in relation to the axles during the statutory tilting test to which public service vehicles are subjected and which is usually complied with only on the borderline of requirements.

As applied to rear-axle suspension the semi-elliptic spring not only fulfils its primary function as an elastic weight-carrying medium but, in addition, serves as an anti-roll device capable of offering great torsional resistance to side sway and roll. In most layouts it also acts as a radius rod to maintain the axle at right angles to the straight-ahead wheel path while it also performs the duties of a torque arm under both driving and braking loads. Several of these requirements are contradictory and various reinforcing members are embodied in the form of anti-roll bars or similar devices, such as torsion tubes or rubber-bushed arms, which do not restrict normal vertical movements of the axle but which supplement the resistance of the leaf springs to twisting about their fore and aft anchorages.

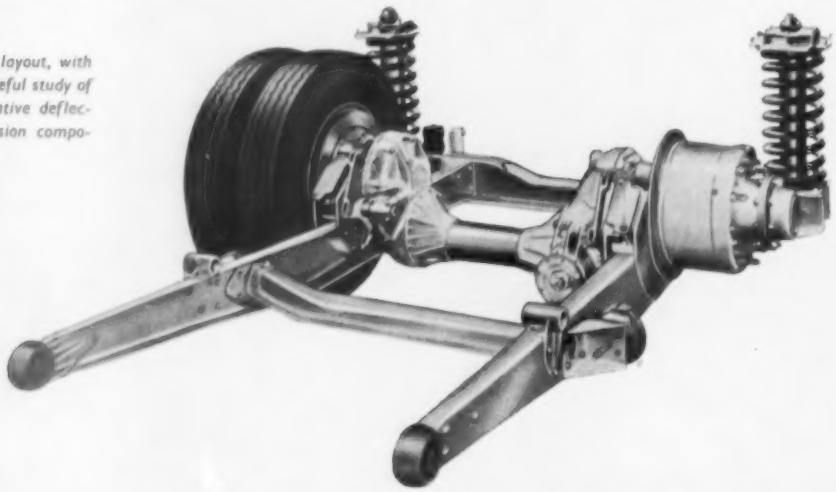
Various forms of rebound and anti-roll clips are in use on laminated springs either to hold the pack firmly together or to reinforce the ends of the main leaves. Where these supplementary devices are fitted to enwrap the eye of the main leaf they not only stiffen the spring against twisting but act as safety retainers in the event of the eye breaking away. Another device in laminated-spring construction is the ribbed leaf in which the spring plates have a raised central rib on one side and a corresponding groove on the other. These ribs and grooves engage each other and so greatly stiffen the spring against lateral misalignment, thus resisting torsion.

A serious problem with springs is the provision of a confortable ride under easy conditions, and adequate resistance to severe deflections, as when subject to a full-load bump. Ideally a two-rate or (better) a progressive spring is required, but, of course, the great problem is the tilt test requirement. A springing system capable of absorbing minor oscillations is not likely to have the torsional resistance needed for passing the tilt test. Conversely, the successful tilt-resisting spring may be so nearly solid as to respond only to the most severe impact loads.

The bump pad is the obvious compromise, although in its most elementary form it does no more than provide a device which, at a certain load, converts the spring into an almost solid and non-yielding member. There are modified types, however, in hollow form and in some cases having suitably dimensioned relief holes, wherein a differential pneumatic action can take place, the rebound effect being reduced as compared with the solid rubber pad. Thus these hollow rubber supplementary springs do indeed justify that description, for while they reinforce in the main springs under compressive load they do not disproportionately accentuate the rebound.

Other components designed to supplement spring action and response by mechanical means are also to be found, ranging from the "helper leaf" to the carefully calculated system of levers and springs embodied in such a mechanism as the Gregoire suspension corrector, made in this country by William E. Cary Ltd. Here one (or two) coil springs are connected between the axle and the frame by a form of linkage which increases the load on the extra springs as deflection increases. The normal laminated springs can thus be redesigned to respond to the higher frequencies and smaller deflections of normal running with the supplementary

In the design of this rear suspension layout, with which coil springs are employed, a careful study of the problems associated with the relative deflections of the suspension and transmission components has had to be made



springs taking on a greater share of the work as deflection increases.

The Cary-Gregoire suspension system has attractive features; it is simple to apply to an existing layout and need not greatly increase weight nor make any considerable demands upon available space. It seems unlikely, however, that it will improve resistance to tilt and indeed might need more support from anti-roll equipment on a double-decker bus than the normal springing.

Although coil springs are used in front suspensions of the wishbone type, their application to rear springing is not common. As already mentioned, in the case of the conventional semi-elliptic layout the physical characteristics of that type of spring enable it to act as an anti-roll device, as a radius arm and as a torque stay: in short, it fulfils all the complex functions involved in what is known as the "Hotchkiss drive".

The coil spring, on the other hand, is an unstable member quite incapable of resisting stresses applied laterally. Thus it will yield to side forces from any direction so that, when mounted vertically to carry the vehicle weight, it has no capacity for action as a torque or radius member; hence all these functions must be supplied by external linkages and levers. In the case of the common type of wishbone front suspension it is the wishbone units that constrain the spring to act in the required direction, while for rear springing some form of linkage must connect the axle to the chassis in a manner which restricts the movement within the required limits; the spring is interposed between the two members to provide suspension only, for it has little or no part in controlling lateral movements. To relieve the linkages which act as torque and radius members of sideways deflections, a transverse link of the type known as a "Panhard rod" is connected between the chassis at one side and to the axle at the other so controlling relative movement of axle and chassis at right angles to the fore and aft centre-line.

As the coil spring has no inherent self-damping, its rebound after compression can be quite violent; therefore hydraulic dampers are highly desirable, if not absolutely essential. Coil springs lend themselves to compact assembly with a telescopic hydraulic damper mounted inside the coil. In some layouts, however, a rubber bump pad is placed within the coil.

Although coil springs in themselves are lighter and simpler than laminated leaf springs and do not call for special servicing attention, they must inevitably be associated with a considerable amount of mechanical linkage, and it is, perhaps, only the advent of pre-stressed bonded-rubber bushings that have brought them into the realm of practicability for public service vehicles. It must be allowed, too, that the bold ideas of an individual and enterprising maker do not necessarily reflect the trend of the entire industry. It may, perhaps, be permissible to suggest that the coil spring is only advantageously applied in connection with those forms of front or rear suspension where the associated mechanical linkage is an inevitable feature of the general design irrespective of the type of springing medium, be it coil, leaf, torsion bar or rubber.

In the case of the A.E.C. coil-spring rear suspension, the axle unit is carried by a hinged sub-frame connected to the body under-framing (there is no chassis as such), and the coil springs are mounted at the back of this member some distance to the rear of the axle. Hollow rubber springs supplement the coil springs after a certain deflection has been passed; telescopic hydraulic dampers are contained within the coil springs.

The construction is interesting in that the rear axle and the open-ended rectangular sub-frame carrying it is hinged to the mass of the vehicle through two rubber bushed pivots; accordingly the assembly can be regarded as a two-wheeled "cart" supporting the rear end of the vehicle.

The side-members of this sub-frame act as radius rods and torque arms, and some relative flexibility is permitted by rubber attachments carrying the axle. The sub-frame is braced by an additional cross-member and it would thus appear that under tilt or excessive roll the two side-arm pivots could be subject to severe torsional loads.

To refer once again to laminated springs, the application of a reverse-camber rear spring in the case of the low-floor Leyland is interesting in that the fixed pivot is at the rear end and the axle is offset towards it. The spring is mounted quite high above the axle while below is a rubber-bushed link extending forward to a point on the chassis below the forward shackle bracket. The linkage thus provided gives a Watts motion to the axle, that is, the axle moves in a vertical plane throughout its full working range. The rear or fixed ends of the springs are always in tension and by the incorporation of suitable helper leaves almost constant frequency throughout the working range is achieved. An increasing number of manufacturers is carrying out investigations with a view to the introduction of suspension systems to give a natural frequency that is constant, regardless of the load carried.

It is worth noting that the rate of the Leyland front suspension (torsion bars, rubber springs and hydraulic dampers) is 1,170 lb/in of wheel deflection at half load while at full load it is 1,400 lb/in. The respective periodicities are 120 and 103 cycles per minute. On the rear suspension (laminated springs with rubber bushes and pivots) the rate varies from 1,200 lb/in unladen to 2,000 lb/in laden, the variable rate being associated with a constant periodicity of 92 cycles per minute. Comparative figures with a Gregoire-corrected semi-elliptic suspension on a bus are 1,100 lb/in (unladen) and 1,528 lb/in (laden), with a constant periodicity of 84 cycles per minute.

Steering

Wider Adoption of Air Pressure and Hydraulic Power-assisted Equipment

THOUGH the main object of fitting power-assisted steering gear to the heavier types of vehicles is to relieve the strain on drivers, the value of this equipment as a means of improving road safety has assumed even greater importance under present-day traffic conditions. Avoidance of accidents may often depend upon a driver's ability to alter course more quickly than he could unaided, particularly if fatigued after long periods at the wheel. Power assistance is thus becoming increasingly appreciated by heavy vehicle drivers, both for negotiating traffic-congested streets and for reducing the risks attendant upon high-speed travel on open roads. It also greatly facilitates the handling of heavy load carrying vehicles engaged upon off-the-road operations over soft and uneven ground and manoeuvring in confined spaces.

That these considerations have led to a considerable demand for power steering equipment is to be inferred from the number of different makes available, mostly offered as optional extras by vehicle manufacturers. In the latest

The Westinghouse air-pressure-assisted steering equipment, as applied with the control valve mounted on the chassis

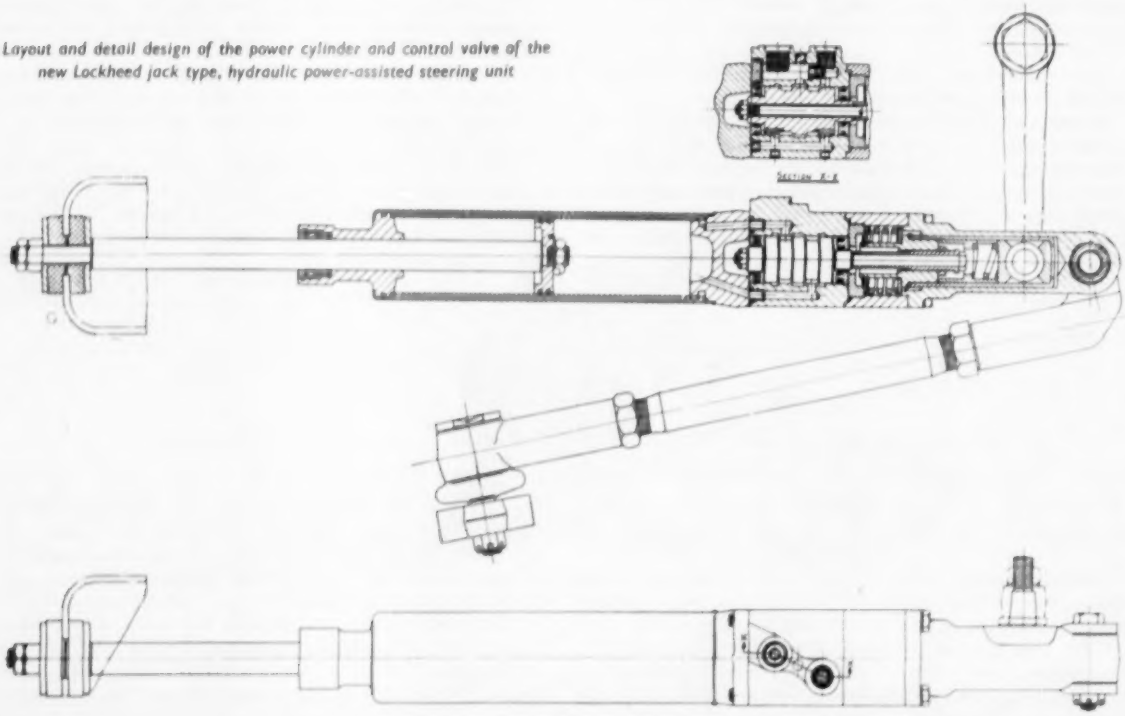
productions, both hydraulic and air pressure types are represented. The former are more generally favoured, though the latter are preferred by some vehicle manufacturers for their heavier machines operating under rough going conditions. This is because the air pressure actuated types are thought by some to be better able to provide protection for the steering mechanism by absorbing road wheel shocks. In most cases suppliers of power steering equipment offer alternative designs to suit different chassis frontal arrangements and also for both original and conversion installations. For conversion it is not generally necessary to make many modifications to existing equipment.

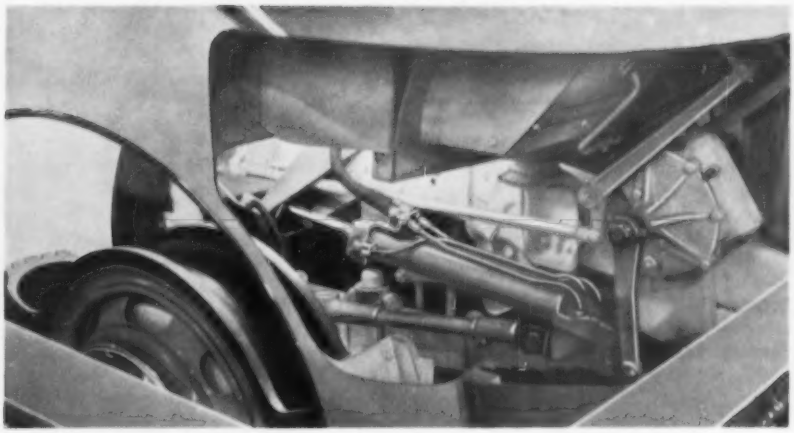
Two versions of the latest Westinghouse air pressure equipment were exhibited at Earls Court, one having a separate control valve for mounting on the chassis and the other with the valve operated directly by the steering column. Both have a double-acting servo cylinder with a clevis or ball joint fixed anchorage. With the arrangement in which the valve is on the steering column, the piston rod is coupled directly to the drop arm, but with the chassis-mounted valve, connection is made through a double-arm relay lever, one arm being linked to the valve operating lever.

A feature of the control valve is that the air used is not exhausted to atmosphere: this reduces the demand on the pressure supply system. The assembly consists of two groups of identical valves. In the neutral position the inlet and exhaust valves are closed and balance valves in each group are open so that the pressures on each side of the servo piston are equalized. With either the steering column- or the chassis-mounted control valve, so long as the steering wheel is being turned and thus is moving the valve operating lever one way or the other, air pressure is admitted on one side of the servo piston and assists the steering effort. Immediately the wheel is held stationary, the valve lever is centred and the valve mechanism returns to the neutral position to prevent further assistance.

The new Lockheed, telescopic jack type hydraulic servo-assisted steering equipment is applicable to existing vehicles in which the drop arm is forward of the front axle; it can be installed without modification of the steering box. One end of the power jack, which incorporates the control valve and hydraulic hose connections, is slightly extended to form a connection for the drag link. This end contains a sliding member, which is centralized by a coil spring and fits on the ball at the end of the drop arm. A spool valve is actuated by the sliding member, and it is centralized by the pre-loaded coil spring. The valve controls the flow of fluid to the jack cylinder, which consists of two concentric tubes and contains a piston connected to an anchorage held between rubber washers to accommodate swinging movements. Drop arm movements in either direction are unassisted until

Layout and detail design of the power cylinder and control valve of the new Lockheed jack type, hydraulic power-assisted steering unit





The latest Girling hydraulic power-assisted steering equipment, fitted to a Bedford Vega passenger chassis

the applied steering effort overcomes the pre-loading of the coil spring and slides the spool valve. Then, fluid is admitted under pressure either directly to the front end of the cylinder or, through the space between the concentric tubes, to the rear end. The degree of assistance given is in proportion to the applied effort.

Similar in layout, operating principle and performance is the Girling equipment, which is for forward-controlled vehicles and is available as a factory-installed optional extra on Big Bedford, Dennis Hefty and Foden chassis. It is basically the same as that adopted as optional equipment for the Armstrong-Siddeley Sapphire car. The single-tube double-acting power cylinder has the control valve incorporated at one end and connected directly to the drop arm. A ball and socket chassis anchorage secures the outer end of the piston rod. When the effort applied through the steering wheel overcomes the resistance of a pre-loaded valve-centring coil spring, the drop arm connection slides between two rows of ball bearings and operates the spool valve. The drag link has a pivoted connection under the valve casing. Detailed and illustrated descriptions of the Girling and the Lockheed servo-assisted systems have appeared in the *Automobile Engineer* this year, in the March and April issues respectively.

Variants of this design include a two-piece type, as used for the Leyland Comet chassis. With this, the hydraulic ram and control valve are separate units, the valve being incorporated in the drag link. For use in cases where considerations of space and steering geometry make it inconvenient to incorporate a valve in the hydraulic ram or drag link, the Company have developed a rotary valve for installation in the steering column or in the hub of the steering wheel. This is connected by rigid or flexible piping to the rest of the system, and affords the same steering characteristics as with other Girling valve units. It is particularly suitable for multi-wheel vehicles with four-wheel steering as it ensures that both sets of hydraulic rams impart equal steering effort simultaneously.

The Hydrosteer link type of hydraulic power-assisted steering equipment, produced by Cam Gears Ltd., is a standard feature of Austin and Morris-Commercial 7-ton vehicles and optional on Commer 5- and 7-ton trucks and 12-ton tractors. Its spool type control valve is incorporated in the drag link. On the Austin and Morris-Commercial trucks, the double-acting ram is mounted in front of the axle beam, to which the ram piston rod is anchored. The cylinder is connected to a steering arm on the off-side stub axle. On Commer vehicles, the axis of the ram is parallel to the longitudinal axis of the vehicle, the piston rod being attached to the chassis frame and both the ram cylinder and drag link connected to the steering arm, which they actuate.

A similar linkage type of hydraulically assisted steering produced by Clayton Dewandre Co. Ltd. is included in a new range to suit different installation requirements. This range is particularly suitable for the conversion of vehicles initially designed for manual steering control. The control valve forms part of an assembly that replaces the drag link, and the double-acting power cylinder is installed preferably between the track road and front axle. With this arrangement the cylinder end can be coupled to a bracket anchored by the spring U-bolts, and the end of the piston rod can be clamped to the track rod. The valve is so designed that a reactive force gives the driver an indication of the intensity of hydraulic pressure and therefore of the power assistance afforded. In another drag link version, control valve movement in either direction is effected against a compressed bias spring, which helps the normal self-centring of the steered wheels.

Another Clayton Dewandre hydraulic-assisted steering, for use in conjunction with a Marles Type 86I steering box, has a reaction valve similar to that used for this makers' air-pressure assisted equipment. It is designed for mounting immediately above the steering box. A double-acting power cylinder is pivoted preferably to a fixed chassis bracket and the piston rod is coupled to the drop arm. In the valve unit, bevel gears reverse the direction of rotation of the steering worm shaft, the reversal being corrected by a worm gear of opposite hand to that normally used. Two bevel pinions in mesh with the bevel gears are mounted on a shaft extended at both ends, one end operating the reaction valves and the other acting between a pair of bias springs preloaded to hold the valves in the central, or neutral, position. As with the drag link type, the arrangement has an assisted self-centring effect.

In addition to these constant-flow hydraulic systems, the company exhibited a power-assisted steering unit for use in a hydraulic accumulator system as supplied for the Scania-Vabis buses and fitted to the American Mack buses. This unit is designed for mounting either on the front axle, with an indirect connection to the steering column, or in the conventional position. It comprises a cylindrical housing containing a longitudinal worm-shaft rotated by steering wheel movements transmitted through bevel gearing. The worm shaft operates a control valve at one end of the housing and a power cylinder piston. Movement of the piston by manual effort at the steering wheel operates the drop arm in the normal way through rack and pinion gear and, as with other systems, assistance is given by action of the control valve which increases the fluid pressure on one or other side of the piston.

Brakes

Progress with Disc Brakes Both of the Transmission and Wheel Types

RECENT developments in brake equipment have been mainly in respect of details. They have been introduced to improve performance and to simplify maintenance. For vehicles of up to 5 tons capacity, hydraulic brakes with or without vacuum servo assistance are almost invariably used, but for larger types, particularly multi-wheelers and tractors, air pressure systems are also much favoured. This applies also to passenger carrying vehicles, with a few exceptions having vacuum servo application.

In disc brakes, the progress made has been mainly in relation to the hand applied transmission type, now officially permitted for passenger vehicles. The new Lockheed example of this type of brake has been developed to cope with the increased weight of commercial vehicles. It incorporates rigid calipers attached to the gearbox or back axle; either one or two calipers are employed, according to the weight of the vehicle. Each caliper carries a pair of cable operated pivoted levers, by means of which circular friction pads inserted in holes in the caliper are mechanically applied to each side of the disc, the pressures being equalized by compensating linkage connected to the outer ends of the levers. The disc is a substantial casting with radial ventilating slots between the two faces to assist cooling by centrifugal circulation of the air. To ensure absolute security, the pads are bonded to circular steel plates, which are let into the friction material. They are independently adjustable by set-screws fitted with lock nuts.

A similar ventilated disc arrangement is used for the transmission disc brake of the new Scammell 30-ton Constructor, six-wheeler vehicle. In this application, when the outer ends of the pivoted levers are forced apart by a wedge-operated expander, actuated by a steel cable, the friction pads on the inner ends are applied on each side. Each pad has independent screw adjustment to take up wear.

The Lockheed disc transmission brake is used as a safety feature on the new Foden heavy vehicle hydraulic braking equipment for which, incidentally, engine oil is used as the fluid. A combined oil reservoir and hydraulic servo carries the brake pedal lever, which acts directly on the servo piston. Should the hydraulic pressure fail, the piston is moved to the end of the cylinder; this permits further movement of the lever which, acting through a linkage system, immediately applies the transmission brake.

The Girling cable-operated automatic adjuster for cam-actuated brakes on commercial and public service vehicles

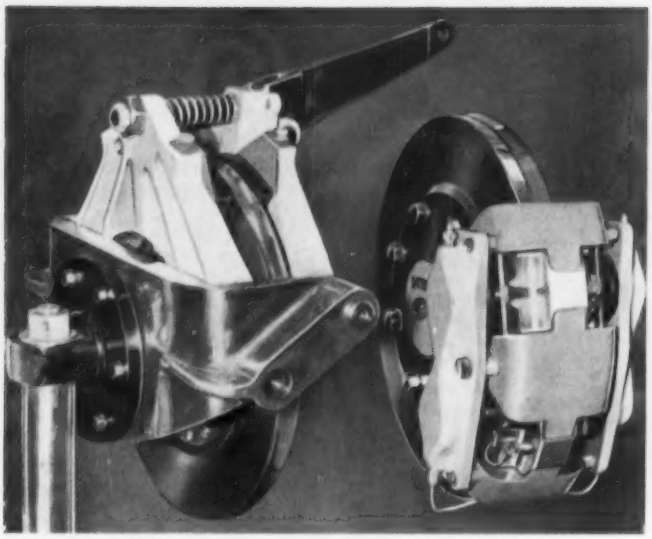
Also of new design is the Dunlop transmission disc brake. Instead of a caliper, there is a trunnion-mounted, cast member on each side of the disc. Deep depressions are formed in these members to assist cooling, and each carries a pair of segmental friction pads. The pads are ¾in thick at their outer edges and taper to about ½in thickness at their inner edges. They are bonded to thin steel mounting plates secured by set-screws. To apply the brake, the side members are tilted inwards by downward movement of a cam lever. This lever is pivoted to one member and connected to the other by a rod passing through a coil spring, which holds the members apart so that the pads clear of the disc when the brake is released.

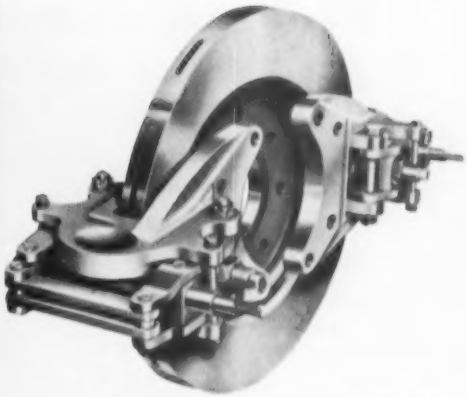
Extreme simplicity characterizes the latest, Dunlop, hydraulic, disc-type wheel brake. The caliper comprises two flanged housings secured on each side of a central member, both containing a pair of hydraulic application cylinders acting on steel plates to which square-shaped friction pads are bonded. Insertion and removal of the pads are effected through apertures in the central member. To replace the pads when worn, it is necessary only to withdraw pins securing their retainer plates

In its latest form the Girling, hydraulic, disc-type wheel brake is also of simpler design than before. The caliper, a one-piece casting, is bored to accommodate the hydraulic cylinders, which apply a pair of segmental friction pads on each side of the disc. A balance tube connection between the cylinders equalizes the pressures. The steel-backed pads are held in position by narrow rataining plates secured to the upper and lower edges of a large aperture in the caliper. Through this aperture the state of pad wear can be seen at a glance and the pads can be withdrawn easily.

An addition to the Girling range of drum brakes is an automatic adjuster for cam-expanded shoes. It operates on the return stroke of the cam lever, when this lever has moved through a predetermined angle. A spring-loaded cable, attached to one shoe and to the lever, passes over an idler pulley and partially round the outer carrier of the adjuster. The carrier contains a spring-loaded plunger, engaged in teeth on the adjuster spindle. Rotation of this spindle actuates the adjuster wedge that expands the shoes. Though every cam lever movement causes the cable slightly to rotate the carrier, adjustment does not occur until the lining wear is sufficient to permit engagement of the plunger with the next tooth on the adjuster spindle. Rotation of the spindle by the adjuster, of course, reduces the shoe clearance.

Clayton Dewandre Co. Ltd. have introduced into this country the American Bendix accumulator system for operating brakes and other hydraulic vehicle equipment. They exhibited a complete set, as supplied for the Norwegian Scania-Vabis buses. The accumulator, of which it is preferable to use two for front and two for rear brakes, is of the spherical type as employed for aircraft. It is designed for a maximum working pressure of 1,500 lb/in². The spherical casing has an oil inlet at the bottom and contains a rubber bag, which is inflated through a Schrader valve at the top. This valve is connected to the vehicle's air pressure system to maintain the required hydraulic operating pressure. Since the lower half of the bag collapses to varying degrees,





Lockheed disc type transmission-brake, with two callipers, for the heavier types of vehicle

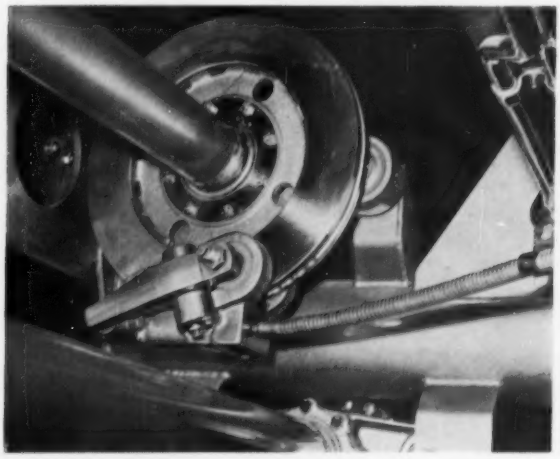
Left : Demonstration models of the Dunlop disc type transmission-brake and the latest hydraulically-actuated disc brake for application to road wheels

according to pressure conditions, it is of thinner rubber than the upper half and incorporates rubbing pads to protect it against chafing due to contact with the inner wall of the casing.

An unloading valve in the air pump-reservoir circuit of the vehicle has non-return valve connections to the accumulators, which are also connected hydraulically to a pedal-operated, dual brake-control valve. When the hydraulic pressure falls below a prescribed minimum, the unloading valve automatically diverts the air supply from the pump to the accumulators and thus restores the normal working pressure. The new brake control valve has independent operating cylinders for connection to the front and rear brakes respectively, so that failure of one system does not affect the other. For the same reason a new safety dual control valve is incorporated in the Westinghouse dual air braking system, the air being taken from two independent reservoirs.

For vehicles with axle loads of 8 to 9 tons, redesigned and strengthened versions of the Lockheed two-leading shoe brakes have been introduced. They have 5in and 7in wide shoes and 16½in diameter front and rear drums respectively.

The cable-operated disc type transmission-brake that is fitted to the Scammell Constructor 30 ton chassis



Their linings are ⅜in thick. For medium duty, Lockheed supply a new 16in × 5in brake, operated by a transverse, cylinder and wedge mechanism. One of the shoes of this brake is of a compound design such that when the drum rotates forwards, both act as leading shoes, and when it rotates backwards the compound shoe acts as a leading shoe and produces a servo thrust on the other through a sliding adjuster mechanism; thus a duo-servo effect is obtained.

Feeny and Johnson Ltd. have added a new safety feature to their vacuum-operated trailer brake equipment, whereby the brakes are automatically applied should the trailer become accidentally detached. The new component is known as the S.B.S. Breakaway valve. It is mounted on the trailer drawbar and is coupled to the rear end of the flexible hose connected to the towing vehicle's vacuum brake system. A pipe connection is taken from the valve to the bellows power unit that operates the trailer brakes. Two more connections are made between the valve and a vacuum tank on the trailer. Normally one of the latter is closed by a plunger in the breakaway valve, while the other communicates through the valve to the flexible hose to maintain vacuum in the trailer tank. The connection to the tank is fitted with a non-return valve. If the mechanical connection between the towing vehicle and trailer is broken, so that the pull of the trailer is transferred to the hose, the plunger is pulled forwards as the hose slides off its outer end. This opens the pipe line from the vacuum tank to the power unit and, at the same time, closes the passage through the flexible hose connection to atmosphere. The trailer brakes are thus immediately applied and remain so until the hose is pushed on to the valve connection and the plunger thus slid back to the running position. Normally the hose connection to the valve is held by a thin aluminium strip which breaks when the trailer becomes detached.

A simple solution of the brake squeal problem was exhibited by the Motor Industry Research Association. It is a metal ring faced with friction material and pressed against the mouth edge of the brake drum by spring clips. Its function is to damp out drum vibrations, and its effectiveness is enhanced by the fact that the ring is in segments loosely joined together by riveted hinge pieces. When the drum vibrates, relative motion between the drum and damper absorbs sufficient energy to prevent the vibrations from building up to an audible level.

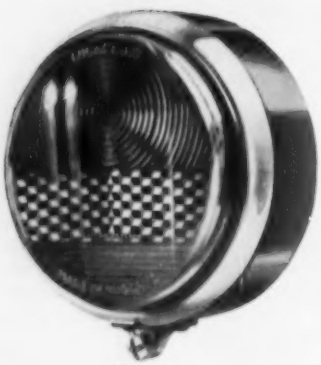
Electrical Equipment and Heaters

Some New Applications, and Cab Heating for Goods Vehicles

As on cars, the general trend on all types of commercial vehicle is one of increasing use of electrically operated accessories and components. The essentials for road safety alone demand additional accessories by way of fog and cornering lamps, windscreen wipers and washers and demisters. There is also the question of driver comfort, a question which has led quite a number of manufacturers (especially of mass produced vehicles) to install a cab heater, or at least make provision for its optional fitment. Moreover, there is a marked increase in the electrical operation of body and chassis units ranging from doors to gear-selector mechanisms.

For the lighter vehicles, particularly those in the delivery van class where short runs and frequent stops and starts constitute the daily round, these additions have necessitated the employment of a higher capacity dynamo and, the use of current-voltage control system of regulation. On other classes of vehicle, the compensated voltage control system of regulation continues to find place, but even here, there are signs that ere long the current-voltage control (or current limit voltage control as it is termed in Simms nomenclature) will be the rule rather than the exception. Moreover, for all classes of vehicle, the additions referred to have led to the adoption of simpler wiring systems, instrumentation and driving controls.

On the Atlantean, the battery is readily accessible



Left : The Lucas model L567 stop and tail lamp

Right : The Ford Thames 7 cwt van with head and side lamps mounted together

Dynamos and control boxes

All makes of dynamo and control board remain much the same as hitherto, such modifications as have been effected being of a minor order and relating chiefly to standardization and production.

Of particular interest in the C.A.V. and Simms ranges of control board are those employing a solenoid relay or contactor type cut-out which, for dynamos with outputs up to about 750 watts, is becoming increasingly popular. Also of particular interest where cut-outs are involved, is the heavy C.A.V. cut-out of a kind known as the "field resistance type" and having the type symbol BCK45. In appearance this unit is similar to other triple contact BCK types, but the essential difference is that instead of acting as a throw-out coil, its external winding is cumulatively wound and connected so as to serve as a dynamo field resistance when the unit cuts out. This action, of course, raises the cutting-out speed of the dynamo to a point somewhat remote from that of the cutting-in speed. By cutting-in at a higher dynamo speed than would otherwise obtain, it becomes (assuming the system is without defect) free from the destructive phenomenon known as "buzzing". Buzzing is the rapid vibration of the cut-out armature with consequent repeated opening and closing of the contacts that occurs in many types of cut-out when, following cutting-out action, the dynamo speed happens to fluctuate slightly above and below the cutting-out speed. As therefore, on the heavier vehicles, the reverse current broken by the contacts may be as high as 8 to 10 amperes (on smaller mass produced vehicles it is between 0 to 5 amperes) the rate of erosion of the contacts is considerable under these conditions. Moreover, as these conditions are more likely to be encountered by the heavier vehicles operating in city traffic crawls, it is evident that the life of the cut-out contacts of such vehicles can be immeasurably prolonged by adopting a cut-out design which provides for a somewhat greater difference between the cutting-out and cutting-in speeds than that obtainable from conventional types.

With regard to the future of generators, there is the possibility of the alternator replacing the dynamo. The

alternator is simpler and cheaper to produce, requires very little servicing because of the absence of brushes and being devoid of a commutator makes for little, if any, interference with radio or television. Its application to goods and passenger vehicles would have taken place long ago had it not been for the difficulty encountered in producing a suitable companion rectifier.

Batteries and lamps

Where batteries are concerned, two main trends obtain, one for acid types, the other for alkaline types. For the former, there has been considerable development in separator materials which provide increased diffusion of the electrolyte and improved support for the plates. These developments have resulted in higher starting performance and longer battery life.

In the alkaline types of battery, development has also been considerable and has resulted in reducing the internal resistance to a comparatively low value. The importance of low resistance is not so much a matter of efficiency, for loss of energy in a battery is relatively unimportant on motor vehicles. On the contrary, it is rather the effect of internal resistance upon the lamp life that is all important. Suppose, for example, the bulbs are rated at 12 volts, then with a six-cell lead-acid battery and a maximum charging voltage of 2·7 volts per cell, the increase in voltage on the lamps would be:—

$$\frac{6 \times 2{\cdot}7}{12} \times 100 = \frac{4{\cdot}2}{12} \times 100 = 35 \text{ per cent}$$

With a comparable nine-cell alkaline battery and a maximum charging voltage of 1·8 volts per cell, the percentage increase would be the same viz:—

$$\frac{9 \times 1{\cdot}8}{12} \times 100 = \frac{4{\cdot}2}{12} \times 100 = 35 \text{ per cent}$$

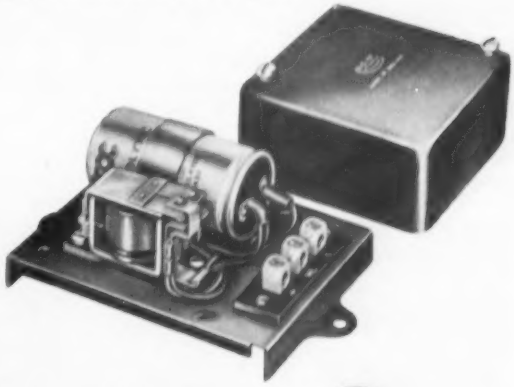
Both these are extreme figures, but they serve to show the importance of internal resistance, and of rating bulbs above their nominal value. They explain too, the development of the low-resistance alkaline cell. Hitherto, 12-volt alkaline batteries had 10 cells, which, of course, resulted in a 50 per cent increase in voltage on the lamps. Today, 12-volt alkaline batteries having only nine cells are standard practice. Moreover, some of the modern alkaline batteries have a maximum charging voltage of 1·65 volts per cell, and others even as low as 1·57 volts per cell. Further developments in this direction, and in the structure of the plates to permit the exposure of a larger surface of active material to the electrolyte can be expected in due course.

Reverting to acid batteries, there were two Dagenite exhibits of particular interest. Of these, the first was one of the largest 6-volt batteries in a moulded container to be produced in this country. It is manufactured to a special design for London Transport. The second was a new feature by way of a lead ring at the base of the terminal posts on all Dagenite batteries. This special feature has been incorporated to minimize the risk of corrosion, and consequently, to reduce the maintenance required by the vehicle operator.

Some modifications in this respect have also been made on Tungstone batteries. The problem has been tackled by a two-fold approach of which one part consists of a specially designed lead bush moulded into the cell lid in a manner permitting the terminal post and the bush to be burnt together to form a solid metal cap so that the cell is completely sealed against acid creepage. The other part consists of a new design of vent-plug which overcomes the problem of acid spray by effecting separation of the droplets and returning them to the cell.

With regard to battery accessibility on buses and coaches the new Leyland vehicle, the Atlantean, provides an example

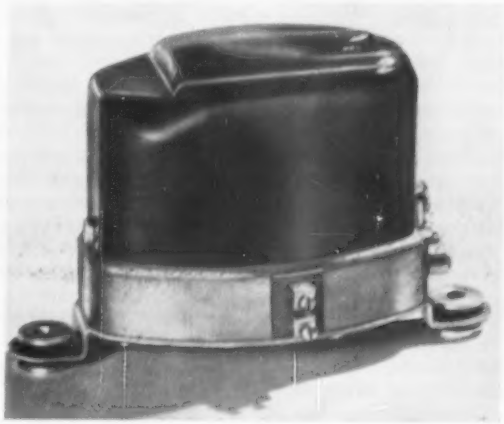
Above : Separate head and side lamps are employed on the Morris J2 light pick-up

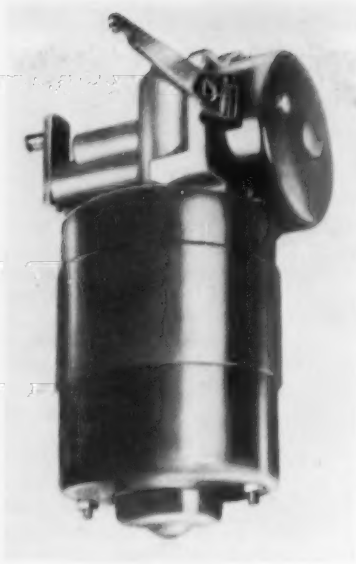


Above : The new C.A.V. flasher unit, illustrated with its cover removed

Right : Control unit for the Trico time-switch type flasher

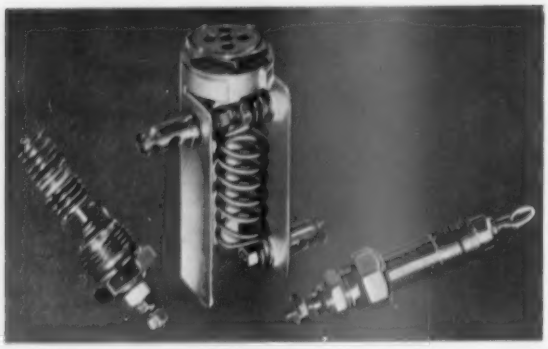
Below : The Trico motor-driven type of flasher unit is easy to mount





Above : Main features of this Delco electric wiper are: self-parking, silent operation, and automatic protection against overload

Below : K.L.G. single- and double-pole heater plug and balast resistor



of battery units located in box-like housings forward of the rear wheels on both sides of the body. Access to the compartments is by means of a readily detachable panel on the side.

In general, the design of lamps remains unchanged, the only notable trend being towards the increase in the size of combined stop and tail lamps, to give additional safety for night driving. A good example of the latest type of commercial vehicle stop-tail lamp is the Lucas Model L 567 which, for the sake of convenience, incorporates the now obligatory reflectors and can thus be used to bring an old vehicle up-to-date and satisfy all rear lighting and reflector regulations. It is designed for fitting in pairs, functions upon a 21/6 watt non-reversible bulb and incorporates a Diakon lens which is weatherproof and impervious to oil, paraffin, petrol and cleaning agents. Some good examples of flexible (rubber) rear lamps were exhibited by Flexible Lamps Ltd. Among the fog and driving lamps were the well-known Notex "Blue-Spot" range. One model, the "Lightmaster" is designed for use as a supplementary headlamp for high speed and projects a spot beam of not less than 1,000 ft in length.

Also remaining more or less unchanged is the position of the driving lamps, typical examples of which are to be found on B.M.C. and Ford vehicles. On the lighter types of B.M.C., notably Austin and Morris, the headlamps are mounted immediately above the sidelamps, whereas on similar types of Ford vehicle, such as the Thames 7 cwt van, the head and side lamps are combined as in American practice. An outstanding exhibit as regards headlamps was the Rutland six-wheeler, which had four.

In the field of tractors and semi-trailers, DAF exhibited a fully-automatic coupling which, by the action of coupling the tractor to the semi-trailer, connects the brake lines and the electrical wiring. The front support is raised automatically thus the driver does not need to leave the cab and can operate the coupling from his seat by the movement of a lever.

Direction indicators and horns

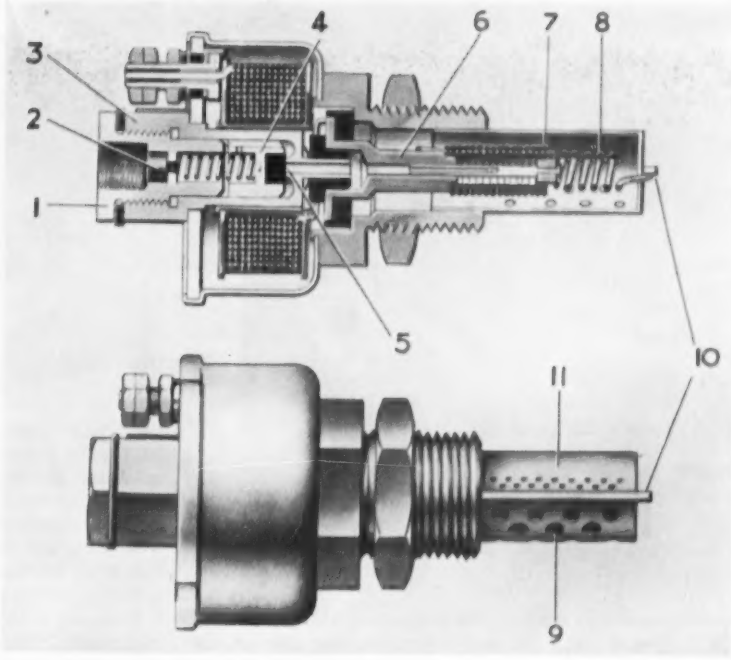
The position regarding direction indicators is still dubious, both as to choice between flashing and semaphore types and between the method of operation of the former. Because of the doubt as to choice between the two varieties, there are available types which serve as a compromise. These can be grouped into two categories, namely: "flashing-semaphore types" and "animated arrow types". The latter are of Simms design and manufacture. Further, in addition to these general trends, the C.A.V. semaphore type with a flexing arm which minimises the risk of damage in the event of its striking an obstacle, continues to be popular.

The doubt as to choice between the modes of operation of the flasher type arises from the fact that two leading makers, C.A.V. Ltd. and Trico-Folberth Ltd., have introduced new models, the operation of which differs entirely from their respective predecessors. The C.A.V. model is condenser-relay operated, whereas the Trico model is motor driven.

Although light and compact, the C.A.V. model is designed especially for public service and transport vehicles. It is of the usual C.A.V. robust construction and the relay, its only moving part, is operated through an electrolytic condenser which is hermetically sealed and unaffected by temperature or moisture. Three types of lamp are available for flasher use, all giving maximum visibility and attention value. They comprise the circular type for front or rear mounting; an "arrow" type lamp, usually for rear mounting, and the "blister" type for side mounting. A large self-cancelling control switch with adjustable time relay, incorporating a warning light, is available, or a simple hand cancelling type selector switch, also with warning light, may be used. The last mentioned units follow the same design as those used

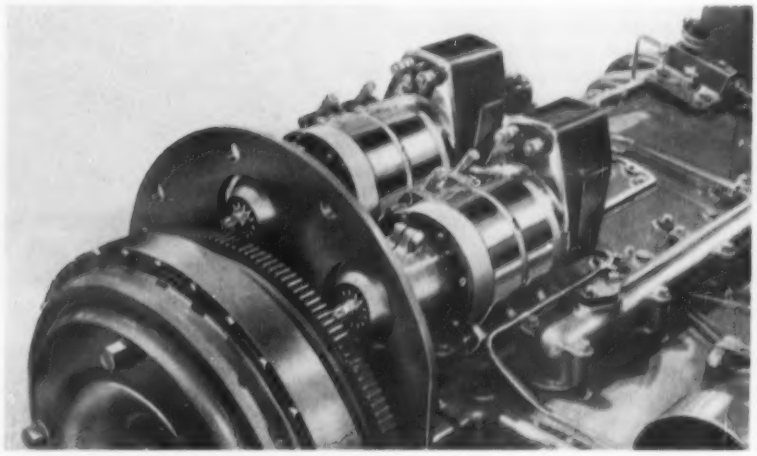
The Commer 15 cwt pick-up is a good example of the British practice of grouping the driver's controls and instruments

Below : The new Trico-Folberth heavy-duty flasher lamp is said to give a long-range signal of high intensity, and it incorporates a secondary system of prisms, which are intended to prevent dazzle



Above : The C.A.V. thermostat unit: **1** *Adaptor,* **2** *Counterbore,* **3** *Core,* **4** *Spring-loaded plunger with valve seats,* **5** *and* **6** *Coil carrier for the heater coils* **7** *and* **8**, **9** *and* **11** *Large and small perforations,* **10** *Diametral shield flange*

Right : Twin starters of C.A.V. manufacture are employed on the British United Traction 200 b.h.p. diesel railcar engine



with the previous C.A.V. motor-driven flasher unit.

For vehicles over 2 tons, Trico-Folberth Ltd. have developed a new flashing lamp signal the optical properties of which it is claimed, are of a high standard, giving a long range signal of high intensity, combined with a secondary optical system of prisms to provide a positive yet dazzle free signal for overtaking traffic. This attractively styled lamp unit is made of Diakon, and robustly constructed to withstand modern vehicle-washing practices. Alternative systems of operation include a motor-driven flasher unit and a heavy-duty time-switch which incorporates a flashing mechanism. The former embodies a high efficiency motor with precision cut gears and a highly developed contact system. It is operated by an illuminated switch which controls the dual circuits of the motor and the two or four lamps fitted. Of the alternative flashing time switch it can be said that it represents a considerable advance in this type of control.

New two-lamp sets for fitment to the sides of commercial vehicles have been introduced by Wingard (M.A.) Limited. They are supplied complete with lamps, bulbs, flasher unit, steering column selector switch and warning light, outlet wiring and self-tapping screws.

Horns remained substantially unchanged.

Windscreen wipers and washers

New equipment in this field is the Delco windscreen wiper. It is a dual speed, self-parking unit incorporating built-in overload protection. It is silent in operation and is based upon the powerful Delco Type 258 motor. Power transmis-

sion is by worm drive through a nylon reduction gear, giving an output torque of 2½ lb-ft at a normal operating speed of 55 r.p.m. When operated upon the higher of the two speeds it rotates at 90 r.p.m. for torrential rain, bad mist or fog. A segmental rotary switch, built in the reduction gear, provides an automatic parking mechanism which returns the blades to a predetermined position when the unit is switched off. To ensure starting under unfavourable conditions the motor is compound wound. The overload protection consists of a thermostat which safeguards the motor should the blades become frozen to the screen or partially or badly seized through any other cause. In its present form, the wiper is standard equipment on Bedford A series trucks and the Bedford CA van.

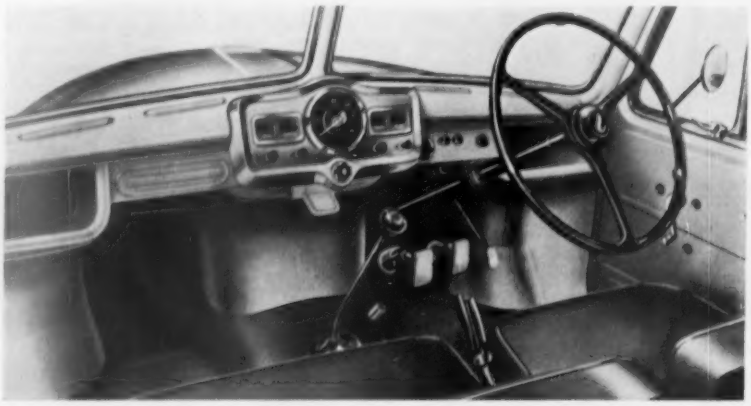
The Lucas Screenjet, following its introduction last year, has found place on a number of the lighter vehicles, and would appear to be widely applicable to the heavier vehicles. Both British and foreign vehicles are adopting dual wipers, notable being the Karrier and the Dodge.

Diesel starting

A new piece of equipment serving as a cold-starting aid for a diesel engined vehicle is the C.A.V. thermostat, type 285. It has been tested down to 10 deg F (−12 deg C) or less in a number of small engines of about 2½ litres capacity. By employing the same fuel as the engine, it overcomes the disadvantages and supply difficulties which would otherwise arise. The device is simple and robust and has few working parts. Moreover, it is actuated by merely pressing a button or turning a switch, thus tedious or annoying preliminary operations are avoided. Designed for threaded location in a horizontal position in the inlet manifold, its installation is a simple matter requiring only a drilled and tapped hole into which it is inserted. Gravity feed from a head of approximately 4in serves as the fuel supply, the fuel container being automatically topped up when the engine is running.

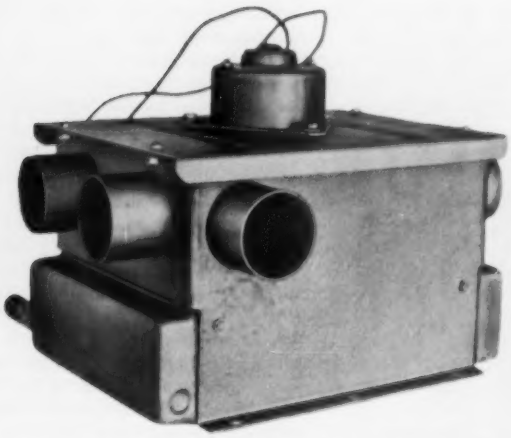
Basically, it consists of a core, a solenoid, a spring loaded plunger which butts against a valve seat, a coil carrier bearing

This model G10 cab heater was shown on the Delaney Gallay stand



The Dodge normal control truck exemplifies American practice in grouping controls and instruments. Dual windscreen wipers are fitted to the tops of the screens

Swedish practice, with regard to the arrangement of controls, instrumentation, cab heating, demisting and defrosting, is shown by this illustration of the Volvo layout. The control for the Eaton two-speed axle can be seen on the gear lever



Above : The Clayton Dewandre GHD3, six-outlet demister

Right : Smith's Radiomobile equipment installed in a coach, showing the control unit and combined microphone and master switch

two heater coils and a cylindrical shield having large perforations on one side, small perforations on the other and a small diametrically disposed flange. As soon as the engine is rotated, air from the inlet manifold enters the shield through the small perforation and mixes with the vapourized fuel within, whereupon the mixture is ignited by the coil and so heats the air for combustion as it is drawn into the cylinders. The flange provides a sheltered zone around the outlet perforations, thereby protecting the flame from the incoming air stream. The operating switch is closed for about 10–15 seconds and then the starter motor is engaged in the usual way. A single rotary switch, incorporating both the thermostat switch and the starter switch, fulfils all requirements of the starting technique and also provides for the operation of the starter alone when ambient conditions are favourable.

Controls and accessories

C.A.V. gear change, Eaton 2-speed axle, and 'Manumatic' and Newton clutch controls, all of which employ solenoid operation, have been covered in the report on the Transmission Systems. Also described is an electrical diesel railcar control developed by Self-Change Gears Ltd. The C.A.V. door control which remains basically unchanged is finding increasing application.

With regard to instrumentation, AC-Delco have introduced new types of speedometer and thermogauge. These will be discussed in our next issue. On some British vehicles, the instruments were calibrated in English and Continental units.

Among the cab-heaters were the Clayton Dewandre CB and a new six-outlet demister, type GHD 3, a new Delaney Galley, type G10, a new K-L demister and defroster, the well-known Smiths 3½ kilowatt unit, and a new Wingard model called the "Sahara".

In the comprehensive range of Smiths Radiomobile exhibits for coaches was the only radio specifically designed for coach use.

Notable among the heater plugs exhibited were the K.L.G. single and double pole types. Ballast resistors for dropping the voltage to suit the plug—a common practice—are also manufactured by K.L.G. The effect of these is noticed, for instance, with a 12-volt system on a four-cylinder engine. If the particular plug specified operates at 1·7 volts, then four such plugs connected in series (as in double-pole operation) require a total voltage of 6·8 volts. Hence, a ballast resistor capable of absorbing the difference up to 12 volts, less a small allowance for "on-load" battery drop, is required.

One of the most creditable exhibits was a new 200 b.h.p. diesel for railcars which, owing to heavy operating conditions, have had to be increased in weight. It was a product of British United Traction Ltd., and equipped with two C.A.V. axial starters, arranged side by side. To ensure simultaneous starting torque from these units, special C.A.V. equipment consisting of trip-contacts and a second "SOL" terminal had been added to each. In this way, a given starter is brought into mesh before the other, but, as soon as the latter completes its meshing, its trip contacts are made to close, causing the solenoids of the two switches to become series connected so that the switches act simultaneously.

Coachwork

Glass Fibre Reinforced Plastics Components are Arousing Widespread Interest

FREQUENT sweeping changes in design and construction cannot be expected. One of the reasons for this, of course, is that operators establish efficient running and maintenance techniques for their vehicles, and any changes that involve drastic alterations to these techniques are undesirable. Moreover, body builders do not wish to upset their well tried production routines unless an alternative can be made to show substantial savings in cost. However, the employment of laminated plastics is evidently justified, for this material has certain operational merits and, from the con-

The body of this Daimler 73-74 seater, double-deck bus, based on a CVG chassis, is constructed by Willowbrook Ltd. Its overall length is 30ft and the overall width is 8ft

however, is the introduction of an entirely new type of chassis, in which the combined strength of the body shell and chassis withstand the loads imposed by the large number of passengers that current regulations allow. An example of this type is the new, Leyland rear-engined chassis, which cannot by itself carry the loads imposed by 78 passengers, and which in any design analysis must therefore be treated as an entire structure rather than as two separate units consisting of body and chassis. The merit of this semi-chassisless arrangement lies in the fact that the body builder, being provided with a chassis frame with all major units correctly positioned, is not restricted in choice of exterior lines or interior arrangements, so long as his structure is mechanically sound and registers with the mounting points that the chassis designers consider essential.

There are, of course, variants of each form of construction. For example, with the traditional method of using an entirely separate body structure, the body shell may be constructed mainly of timber, with steel reinforcement; or, as is becoming more general, it may be produced entirely in steel or light alloy, or perhaps a combination of both. Whilst these remarks on constructional methods have been made with regard to passenger-carrying vehicles, obviously the builders of goods-carrying vehicles have been influenced by developments in this allied field.

In the new Leyland Atlantean double-decker there are many features that exemplify some of the latest advances in passenger vehicle development. In the first place, this public service bus represents the intermediate stage between the traditional style, in which the chassis is a self-contained unit, and the more modern type of body designed to take all the load. The frame, together with the major mechanical units, forms a self-contained assembly, which can be road tested and driven from one factory to another. Nevertheless, without the added strength of the body structure, it would not be capable of carrying the full operating loads. A rear-engine layout has been adopted, so there is no difficulty,

structor's viewpoint, has the advantage that it can be formed without recourse to highly skilled labour, a point that seems to appeal to some bus builders.

The increasing use of plastics was a prominent feature of the Exhibition. Both large and small components composed partly or wholly of resin-bonded glass fibre were shown; they range from a complete outer panel of a roof to the door of a luggage compartment. It is apparent that plastics material will be applied more generally in construction. Apart from lightness and ease of manufacture, the improved thermal insulation obtainable with this material is of importance.

On the subject of body construction methods, there is still no hard and fast rule to be followed, for the traditional method of building composite coachwork on a normal chassis frame remains in common use. It would seem that the integral method, which was a feature of the last Show, has not yet gained much ground, although its value in reducing weight is unchallenged. Of particular interest,

A trunk lid entirely composed of glass fibre reinforced plastics is employed on this body built by Plaxtons Ltd. on a Maudslay chassis. Since it has not any metal framing, the thickness of the plastics laminate is increased locally to form bases for the mounting of components such as hinges and locks

Weathershields glazed ventilating panels are fitted in the roof of the Duple luxury coach on the Commer chassis; they are adjustable to any one of three positions. The front canopy is equipped with tinted transparent panels, which can be omitted if the customer requires a forward-facing destination indicator to be fitted

so far as the body floor is concerned, in respect of the provision of clearance for units such as the propeller shaft. The height of the floor of the saloon gangway above the ground is 17¼in, laden, which by suitable floor arrangement, incorporating a slight curvature, gives a step height of 14in. The advantages of this low floor are reflected in the overall height of the double-decker, which in the laden condition is only 13ft 2¾in; the headroom is in no way restricted.

Another advantage of the rear engine position is that the main entrance door is at the front, on the near-side. This brings it under the immediate control of the driver, an arrangement that promotes safety and leaves the conductor free to attend to his duties in other parts of the vehicle. Power-operated, double folding doors are employed, and they give direct access to the stairway leading to the upper saloon. The economy in space that the rear engine location makes possible enables 78 passengers to be accommodated, 44 in the upper saloon and 34 in the lower saloon.

In the construction of the body, which has a light steel frame panelled in aluminium, the pillars are joined to the outriggers of the chassis frame. Weight has been saved by the adoption of this semi-unitary method of construction: the vehicle has an unladen weight of 7¼ tons. This result has been obtained without adopting unorthodox methods of design or construction, so there can be no doubt that the vehicle will be satisfactory so far as durability is concerned. Despite the large seating capacity, the specification permits a degree of manoeuvrability that compares most favourably even with smaller vehicles. Obviously, this advanced design will have a great influence on future developments in the large-capacity, public service vehicle field.

Another noteworthy large-capacity body is the 73-74 seater, double-decked saloon shown by Daimler. It is based on a CVG chassis, and is constructed by Willowbrook Ltd. Naturally, full advantage has been taken of the increase in maximum permissible dimensions; the overall length is 30 ft and the width 8 ft.

For operators who require open-top service vehicles during the summer season, for example at holiday resorts, there is much to be said for the dual-purpose body on a Regent Mark V chassis. This body was developed by Park Royal Vehicles Ltd., and was shown by A.E.C. Ltd. It has a lightweight upper saloon roof, of plastics material, which can be entirely removed, the joint being at a level just below the windows. The roof unit, complete with glass, weighs about 6 cwt. For detachment during the summer months, any suitable tackle can be employed and the roof assembly can remain slung in the roof of the garage if necessary. With the plastics roof removed, the bus is a normal type of open-top vehicle. To conform to legal requirements, a hand rail is fitted round the top deck. The structure that supports the plastics roof is based on a light alloy member, which forms the main lower unit and follows the plan contour of the upper saloon waist. A secure junction between the two units is ensured by the use of bolts, an overlapping moulding giving a neat weatherproof finish to the joint. Obviously the employment of a detachable roof avoids the necessity for storing fine-weather vehicles during the winter months. This is an example in which the full benefits of plastics materials, with their saving in weight, have been utilized to effect economies in operation.

Another example of a body in which plastics is used extensively was that shown by Plaxtons Ltd. on a Maudslay chassis. The plastics panels are incorporated to minimise weight, for economy in manufacture, and to minimise cost of repairs to damage sustained accidentally in service. This 41-seater coach body has plastics panels at the rear corners, and for the front panel which incorporates the housing for the radiator grille and headlamps. Of even greater interest from a technical point of view, is the use of a trunk lid that is entirely composed of glass fibre reinforced plastics without any metal framing. The thickness of the glass fibre reinforced panelling, in general, is approximately $\frac{1}{8}$ in, but it

Right: Duple Motor Bodies Ltd. manufacture this luxury coach on a Commer chassis. It has comfortable seating accommodation for 33 passengers, but can be equipped to seat 41 people. In addition to the luggage compartment at the rear, there are lockers in the side skirting panels

Left: A noteworthy feature of this Weymann Arcadian, on the Leyland Worldmaster chassis, is its comprehensive air conditioning system to suit overseas requirements. The air conditioning equipment has been developed for this particular application by J. Stone & Co. of Deptford. It can supply cool, filtered air in quantities such as would be required when the vehicle is used in tropical countries

This striking Ghia-styled luxury coach on a Leyland chassis incorporates air conditioning equipment but, unlike the Weymann Arcadian, it has windows that can be opened on each side

is increased at various points, such as hinge and lock mountings. This lid has the advantage of being very easy to balance and light to operate. Relatively simple moulds are involved in the manufacture. While it is difficult to state, without actual experience, just how durable this plastics luggage compartment door will be, there seems to be no reason why such a lightly stressed unit should give trouble. The material takes a good finish, and the saving in weight is 14 lb. This touring coach has an entrance at the front on the near-side, and for the comfort of passengers, Clayton Dewandre under-seat heaters are installed.

The new Crossley Bridgemaster is a large-capacity, double-deck bus, in which the unitary, or chassisless, method of construction is employed. Its capacity is for 72 seated passengers, and its height is 13 ft 5¼in, unladen. In the construction of this body, light alloy members are extensively used, with the result that the unladen weight is only 7 tons 17 cwt 2 qrs. The major units are attached at locally reinforced points of the main body structure. The low overall height has been obtained by particular care in the layout of the transmission units, in which the specially designed rear axle has an offset drive. Convenience of passengers in both saloons has been studied in the arrangement of the central gangways.

Duple Motor Bodies Ltd. exhibited a well appointed luxury coach, of the type for which this manufacturer is well known. It is in the class of vehicle that is popular for long-distance touring, both in this country and abroad. Special attention has been devoted to the design and trim-

Layout of the front end of the Ghia-styled Leyland coach

ming of the seats, which are in moquette over shaped, foam-rubber foundations on the cushions and squabs; head rolls are also provided. In the vehicle exhibited there was comfortable seating accommodation for 33 passengers, although this body can be equipped to seat 41 passengers. The entrance door is at the front on the near-side, and opposite it is an emergency exit in the off-side panel. In addition to the luggage accommodation available at the rear, there are also luggage compartments in the side skirting-panels. A Weathershields glazed ventilating panel is fitted in the roof. This panel is adjustable to any one of three positions. The front canopy has tinted Perspex panels, which can be omitted for the accommodation of a destination indicator. Hard-wood is used for the body frame and is suitably reinforced where necessary with steel and light alloy. The panelling is in aluminium, with Zintec steel at the lower rear corners. A Commer diesel-engined chassis is employed. Another model that was shown by Duple is the 41-passenger luxury coach on a Bedford Vega, which is of similar construction. It is designed for express service, private hire work and touring operation. This body in general follows the lines that have become traditionally associated with Duple coach bodies.

The Weymann Arcadian overseas luxury coach is designed specially to suit the Leyland Worldmaster chassis. Its body structure is entirely composed of steel. The pillars are fabricated from two T-section steel members united vertically by a channel section to form an exceptionally strong box section. One component of each member is continued vertically to form a transverse roof member; longitudinal spacing is maintained by the cant rails and purlins.

This 40-seater coach is noteworthy because it is equipped with a comprehensive air conditioning system, developed for this particular application by J. Stone and Co., of Deptford. The installation can supply cool, filtered air in quantities such as would be required when the vehicle is used in tropical countries; alternatively, if the ambient temperature is low, it is also possible to feed moderately warm air into the vehicle. In the plant, the compressor is operated by a separate power unit, and the whole assembly, including the condenser, is installed beneath the body. Air is supplied through louvres, in the front canopy, directly to an evaporator unit that passes cooled, filtered air through ducting in the passenger compartment roof and through grilles into the main saloon. Thermostatic control is incorporated to maintain predetermined temperature conditions within the body. It appears that having once set the equipment in motion, the driver has little need to be concerned with the

working of the apparatus. This equipment will be of considerable interest to bodybuilders who have a market in tropical countries.

The installation of reliable air conditioning equipment renders unnecessary the use of opening windows; it would be undesirable to admit external air in the normal way, since thermostatic control would be seriously impaired. Therefore, in this coach, the windows are fixed. Reclining seats are provided for the 40 passengers. Special attention has been devoted to the accommodation of luggage: there is a rear compartment with a capacity of 85 ft³, whilst underfloor lockers with access doors at each side, give a further 77 ft³ each.

Air conditioning is also a feature of the Ghia-designed body among the Leyland exhibits. This Italian-built body is of striking character, as would be expected from a stylist who has established a world-wide reputation for his private car designs. It has many features that warrant careful investigation and some will probably be seen in modified form on subsequent productions. Outstanding features of this 40-seater coach are the formation and contouring of the front and rear panels; the front panels, for example, have a forward slope, whilst the rear panels are dominated by side panel extensions carrying lighting auxiliaries. Entrance to the body is through a coach door at the front on the right-hand side. Immediately inside this door, against the front bulkhead beneath the screen, is the air conditioning equipment, which distributes treated air through ducting along each side of the body.

The integral construction that Thomas Harrington Ltd. introduced two years ago, using Commer units, has been maintained without radical alteration, for it has been found that this system has given every satisfaction and is widely appreciated by operators who have had experience of it. In the 60-seater double-deck bus built by Charles H. Roe Ltd. and shown on an A.E.C. chassis, a combination of structural materials was to be found. For the structural members of the lower saloon, teak has been used in combination with a soft-wood floor, whilst the upper saloon framing is of light alloy members, and the floor is of resin-bonded plywood. The vehicle is intended for the home market. This combination of different modern constructional methods appears to provide durability with reasonably light weight: the body weight is 2 tons 14 cwt 3 qrs. Light-weight tubular framed seats are employed; in the lower saloon the trimming is in moquette with leather borders whilst, in the upper saloon, leather is used throughout. The staircase is of the Roe safety type, incorporating two passing-platforms and forming a coat-hanging compartment. In the upper saloon there are eight opening windows of the Widney Famco double-

In this 60-seater double-deck bus, built by Charles H. Roe Ltd., the lower saloon is framed with light alloy and the upper with teak

Above, left: The fin-like extensions of the rear quarter panels of the Ghia-designed coach are reminiscent of private car styling techniques

Left: Distinctive features of this Harrington 41-seater Contender chassis are the treatments of the front panel, canopy and cant rails

Illustration of the arrangement of the ladder that gives access to the luggage rack on the Albion 44-seater bus by Mulliners Ltd.

sliding type, while the lower saloon has four of the same pattern.

An all-metal, 35-seater service bus on an Albion chassis was shown by Mulliners Ltd. The body, which has a double-folding entrance door at the front on the near-side, has double-seats throughout, except at the rear of the body, where there is a seat for five passengers. For some years this coachbuilder has produced a basic type that can be modified to suit differing chassis; various seating plans are also offered. On their stand, there was, for instance, a service bus body on an Austin 15 ft wheelbase chassis. In one vehicle shown there were transverse seats, each taking three passengers, on the off side, a longitudinal seat for twelve on the near side, and a seat for five against the rear panel. The total seating capacity of the vehicle is 44.

An alternative arrangement, providing 43 seats, features transverse seats for three passengers on the off-side, followed by a double-seat over the wheel arch, and finally accommodation for three immediately in front of the normal five-passenger seat against the rear panel. The full complement is made up by a near-side seat for twelve. The advantage of this alternative plan is greater comfort for the passengers in the seat above the off-side wheel arch. In the building of the body, steel sections are used for the framework, and the interchangeability of components is a special feature of this Mulliner system, which is designed for economy both with regard to production and replacement.

Some idea of the attention that is given to the needs of operators was exemplified in the 37-seater service bus that Park Royal Vehicles Ltd. exhibited on an A.E.C. chassis. This body, which is for service overseas, has a framework of high-duty alloy material. It represents the latest development in the constructional methods that this well known bodybuilding firm has evolved. Among the special features incorporated to suit the operator are four pairs of pram-carrying hooks below the lay-back screens at the front end. There is a front entrance and a central exit, each equipped with electro-pneumatic doors. At the centre exit, a sensitive edge and treadle mat is provided for safety; the controls operate in conjunction with an interlocking arrangement connected to the throttle. The roof is fitted with a deep luggage rail assembly at each side.

An unusual feature of the 39-seater, luxury coach shown by W. S. Yeates Ltd., on a Crossley chassis, is the design of the seats. These, unlike the conventional pattern, have what appear to be individual squabs, each with a shaped upper edge, giving a gap in the centre, which is spanned by a curved grab handle. Thus, the grab handle is incorporated

Above : Headrests embodying grab handles are incorporated by W. S. Yeates Ltd. on this Crossley luxury coach

Left : This A.E.C. bus for overseas operation has a body built by Park Royal Ltd. On its roof is a deep rail assembly for the carriage of luggage

Above : Nine passengers can be accommodated in the recently introduced Austin Omnicoach. Many of the pressings used in its construction are common to the Omnivan, Omnitruck, and other B.M.C. vehicles of similar design

MOTOR SHOW

Special Number

THE Show Review number of the *Automobile Engineer* will be published on Wednesday, November 28th. It will constitute a critical review of the more interesting exhibits and will have numerous illustrations of special features and design characteristics. This special issue can be obtained by order from newsagents throughout the United Kingdom, price 3s. 6d. net. Readers are reminded that it is necessary to make arrangements with a newsagent to ensure that a copy is secured.

Right : Jenson Motors Ltd. have developed a light-weight cab entirely composed of resin-bonded glass fibre plastics. Metal is used only in the door hardware

without encroachment upon the relatively limited space between the seat-back and the cushion of the seat immediately behind. The upper surfaces of these seat backs have readily detachable covers. In this type of body, which may be employed for long-distance Continental touring, ease of replacement of trimming surfaces that may become soiled is a desirable feature. As is the common practice of this coachbuilder, the styling of the luxury coach has a distinctly Continental flair, with well swept polished-metal mouldings and free-flowing curves for the roof and rear panel contours. The aluminium panelled body is constructed of light alloy members.

There is evidence of an increasing demand for passenger vehicles having a capacity smaller than that of the normal service bus. This demand originated mainly from public authorities who require buses to provide moderate comfort for journeys of limited length, as for example, for the transport of patients to and from hospital. Vehicles of this type are produced by Kenex Coachwork Ltd., who generally convert a standard goods-carrying van, by the addition of windows and seats, into a comfortable passenger-carrying vehicle. Of the models exhibited, one was a Bedford 15 cwt body converted to a 12-seater. The exterior of the vehicle above the waist is equipped with wood fillets in shooting brake style. Beside the driver, there is a two-passenger seat, which folds forward to allow passage from the front door to the rear seats. At the back there is one bank of three forward-facing seats, and a centre seat is designed to pivot to allow passage to two longitudinal, three-place seats, arranged one on each side of the body. All are trimmed and padded with Hairlok on Pullman high-carbon-steel spring cases.

Among the B.M.C. exhibits, the new Austin Omnicoach attracted a great deal of attention. It has accommodation for nine passengers in addition to the driver. From a technical viewpoint, the interest in this body lies in the fact that it is developed from the Austin Omnivan and Omnitruck; all three vehicles have the same basic pressings, since the design features integral construction. These remarks, of course, also apply to the similar range of Morris vehicles. In the passenger compartment, there is a door in the near-side panel and another in the rear panel. This arrangement is common in this small, compact type of passenger-carrying body, because the limited dimensions preclude spacious gangways, and every inch of available space must be used for seating. There is a waist-high bulkhead behind the driver's seat. In general outline, the Omnivan model is similar to the Omnicoach, with the exception that it has not the side windows behind the bulkhead. Similarly, the Omnitruck has the same basic lower panels and front doors.

For many years, Jensen Motors Ltd. have been associated with the production of light-weight goods-carrying vehicles, and recently, further to enhance this desirable feature, they have developed a light-weight cab entirely composed of resin-bonded reinforced plastics; metal is used only in the door hardware. As a matter of interest, the door locks are of the *planted-on* type. Plastics material is employed for saving in weight, and also to help in silencing and thermal insulation. Since this manufacturer has had experience in the production of plastics bodies for high-speed cars, this new goods vehicle development is unlikely to give trouble.

The use of plastics material has extended to goods-carrying vehicles. In a body by Marshalls Flying School Ltd., of Cambridge, resin-bonded glass fibre is used for the bonnet-top panel, and a further saving in weight is obtained by the adoption of an aluminium fuel tank. All sections of the bodybuilding industry are interested in this plastics material, as a weight saving measure, and its versatility is such that the material is now being used for many purposes.

CRANKSHAFT HARDENING PLANT

New Radyne Induction-Heated Equipment for Medium-Rate or Batch Production

INDUCTION heating, by virtue of its rapidity, cleanliness, ease of control, and consistency, shows to advantage in continuous high-rate production. In operations such as the hardening of the journals and pins of internal combustion engine crankshafts, the advantage is best realized in conjunction with a system of automatic quenching and with a precisely controlled time cycle. This commonly necessitates the design and building of special equipment to meet the requirements of a specific component or to suit the cycle time of a particular production line.

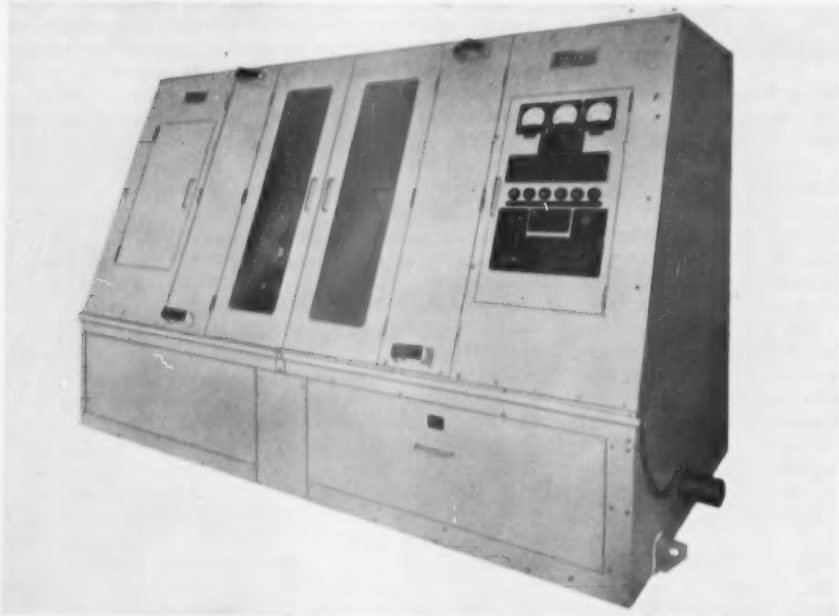
The new Radyne induction hardening unit for crankshafts, recently introduced by Radio Heaters Ltd., of Eastheath Avenue, Wokingham, Berkshire, is designed for wide application in cases where only a modest rate of production is required. Jig plates to receive and support the work are built up with standardized heating and quenching units. Should the plant be used in batch production, a change-over is easily effected by the removal of one set of jigs and the drawer containing the process timers controlling the heating and quenching cycles, and their replacement by others for the next component to be treated. Normally the plant is powered by the Radyne C500, 50 kW output, induction heating equipment operating at 450 kc/s. It is intended to provide a simple and economical method of processing crankshafts at a rate of a few hundred components per week.

Robustly constructed on a heavy steel framing, the unit accommodates two crankshafts and is completely enclosed during operation. Jig plates are mounted substantially vertical over a large tank and the shafts are loaded and unloaded manually through a pair of large access doors. A control panel mounted on the front of the casing provides facilities for either fully automatic or manual operation. The weight of the complete unit is approximately three tons.

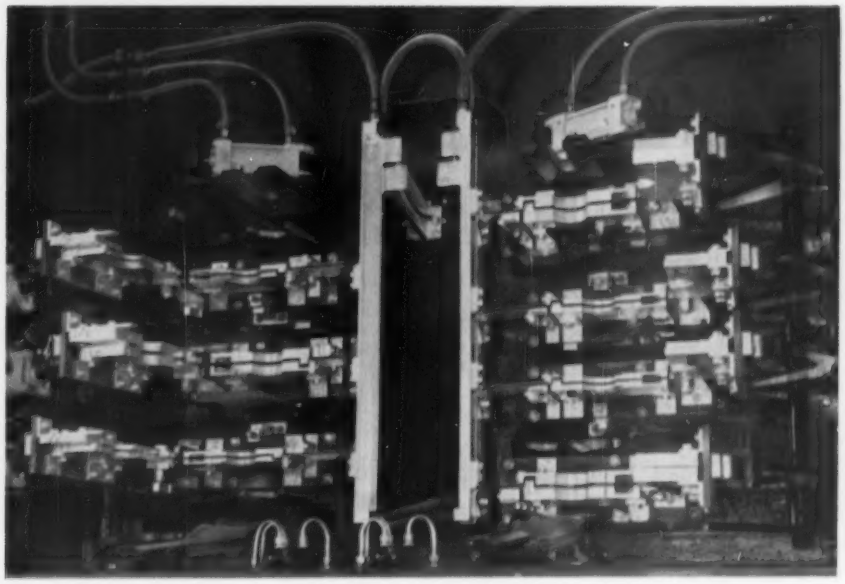
An illustration shows the jig plates for a four-throw, three journal crankshaft. Two journals and two crankpins are treated at one station while the centre journal and the other two crankpins are treated at the second station. The inductor coils, on hinged mountings, are connected in parallel. Air rams close each inductor coil in turn so that R.F. power is fed to only one coil at a time. An automatic re-matching unit maintains maximum loading on the generator throughout the heating cycle in order to ensure operation of the plant at maximum efficiency.

In normal operation, with two crankshafts mounted in position, the heating and quenching cycles are automatically controlled and sequenced. An automatic switching mechanism arranges the heating cycle to be conducted on a bearing surface on one crankshaft, while a quenching cycle is being performed on the other crankshaft. At the end of each heating cycle, water is automatically flooded over the heated surface and simultaneously the R.F. is switched to an inductor coil on the other crankshaft. At the conclusion of the complete automatic cycle, one finished crankshaft is removed, the other shaft is transferred to take its place, a new crankshaft is loaded into the vacated jig, and the cycle is recommenced.

Should it be desired to harden an individual bearing on a shaft, the control is changed over to manual operation. A single heating and quenching cycle can then be performed on the particular bearing to which a selector switch is set. In the event of the heating coil system being shorted out by swarf or other foreign matter, the heating cycle is stopped



The Radyne plant for the induction hardening of the bearing surfaces of crankshafts of up to six throws and an overall length of 42in



Two shafts are accommodated on jig plates equipped with hinged inductor coils and automatic quenching units. The work is progressed through the two stations to give an output of one treated shaft per cycle

automatically, a warning light is illuminated and an alarm bell is operated.

Jig plates can be supplied to specific requirements for two-, four-, and six-throw crankshafts of from 25in to 42in in overall length. A supply of water at a pressure of 60 lb/in^2 is necessary for cooling and quenching services. Water consumption during operation is at the rate of 2 gal/min for cooling the inductor coils and a further 10 gal/min for quenching the heated bearing surfaces of the two crankshafts undergoing treatment.

INSTITUTION OF MECHANICAL ENGINEERS

Forthcoming Meetings of the Automobile Division

NOVEMBER

London

Tuesday, 13th November, 4.30 p.m., at 1 Birdcage Walk, Westminster, S.W.1. General Meeting. Five papers on "Research in Automobile Stability and Control", by authors from the Cornell Aeronautical Laboratory, Buffalo, U.S.A.—William F. Milliken, Jnr., David Whitcomb, Leonard Segal, Albert Fonda, William Close and Clifford L. Muzzey.

Birmingham and Coventry

Thursday, 15th November, 6.30 p.m. Joint Meeting in St. Mary's Hall, Coventry. Five papers on "Research in Automobile Stability and Control", by authors from the Cornell Aeronautical Laboratory, Buffalo, U.S.A.—W. F. Milliken, Jnr., D. Whitcomb, L. Segal, A. Fonda, W. Close and C. L. Muzzey.

Derby

Monday, 19th November, 7.0 p.m., in the Midland Hotel, Derby. Address by the Chairman of the Automobile Division, A. G. Booth, M.B.E. (Member), entitled "Experiences During Forty Years of Automobile Design".

Luton

Monday, 19th November, 7.0 p.m. in the George Hotel, Luton. Five papers on "Research in Automobile Stability and Control", by authors from the Cornell Aeronautical Laboratory, Buffalo, U.S.A.—W. F. Milliken, Jnr., D. Whitcomb, L. Segal, A. Fonda, W. Close and C. L. Muzzey.

North-Eastern

Wednesday, 21st November, 7.30 p.m. in the Chemistry Lecture Theatre, The University, Leeds. Paper: "Rubber Springs for Vehicle Suspension", by A. E. Moulton and P. W. Turner.

Scottish

Monday, 19th November, 7.30 p.m., in the Institution of Engineers and Shipbuilders, 39 Elmbank Crescent, Glasgow, C.2. Paper: "Construction and Use of Earth Moving Vehicles", by William Rankin, A.M.I.Mech.E.

Western

Friday, 30th November, 6.45 p.m., in the Royal Hotel, Bristol. Paper: "Heating and Ventilating Systems for Passenger Service Vehicles", by Wing Commander T. R. Cave-Brown-Cave, C.B.E. (Member).

DECEMBER

London

Tuesday, 11th December, 6.0 p.m. General Meeting. Paper: "Rubber Springs for Vehicle Suspension", by A. E. Moulton and P. W. Turner.

Coventry

Tuesday, 4th December, 7.15 p.m., in the Grosvenor Room, Leofric Hotel, Coventry. Paper: "A Standard Procedure for Brake Testing", by F. W. Bromley.

Luton

Monday, 3rd December, 7.30 p.m. in The Assembly Room, Luton Town Hall. Address by the Chairman of the Automobile Division, A. G. Booth, M.B.E. (Member), entitled "Experiences During Forty Years of Automobile Design".

North-Western

Tuesday, 4th December, 7.15 p.m. in The Engineers' Club, Manchester. Paper: "Automobile Design from the Safety Angle Today and Tomorrow", by A. Bourne.

CURRENT PATENTS

A REVIEW OF RECENT AUTOMOBILE SPECIFICATIONS

Engine cooling and vehicle heating

By the provision of two-diameter pulleys for the belt drive of the radiator fan, this system can be adjusted to suit either winter or summer conditions. Air warmed by passage through radiator A is collected in a cowling B which has an aperture closeable by a flap C and a conduit D leading to the passenger compartment. This conduit has a junction, controlled by flap valve E, by which the air can alternatively be discharged through pipe F to atmosphere.

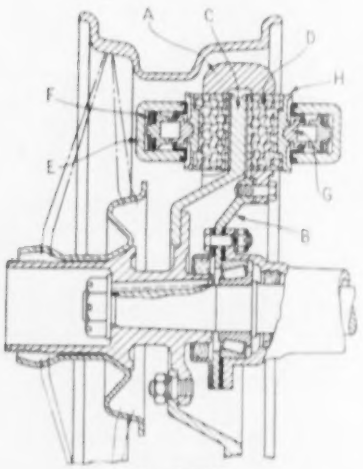
In summer, when vehicle heating is not required, the fan is driven at the higher speed, flap C is opened and flap valve E closes conduit D, as illustrated. For the winter months the fan drive is changed to the lower speed, flap C is closed and pipe F is closed.

The power absorbed by the fan at the lower speed is approximately one-fourth of that required at the higher speed, which has a favourable effect on the available useful power and on the rate of fuel consumption. *Patent No.* 746934. *Daimler-Benz A. G. (Germany).*

Disc brake

The rapid generation of heat in braking high-powered vehicles, or heavy commercial vehicles, tends to cause trouble not only by brake fade but also by the heating of the hydraulic fluid and by deterioration of the plunger seals. To avoid these difficulties the operating cylinders of this disc brake are spaced from the caliper to isolate them from parts liable to be heated during operation.

A caliper A supported on a torque plate B secured to the axle casing, straddles the periphery of the brake disc C and each limb is bored to receive two friction pads D. The cylinders E are formed in twin blocks which are secured to the caliper by set-screws passing through spacing pillars. Each pillar is registered in the caliper and is surmounted by a spring which maintains a small clearance between pillar and



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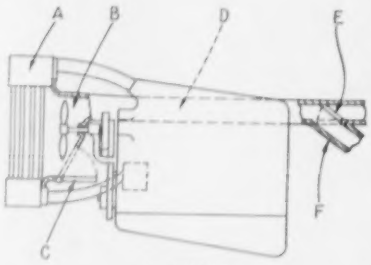


No. 746934

cylinder block to accommodate differential expansion in operation. The open ends of the cylinders are aligned with the friction pads D.

The inoperative face of each plunger F is recessed to receive one end of a cylindrical distance piece; the other end being accommodated in a recess in a pivot member G. On the opposite face of this member is a part-spherical projection which is seated in a complementary recess in the backing plate H, securely registered in the friction pad. An annular rubber shield is clipped into grooves in member G and the end of the cylinder to exclude water and foreign matter. *Patent No.* 747965. *Dunlop Rubber Co. Ltd. and H. J. Butler.*

Metal working tools

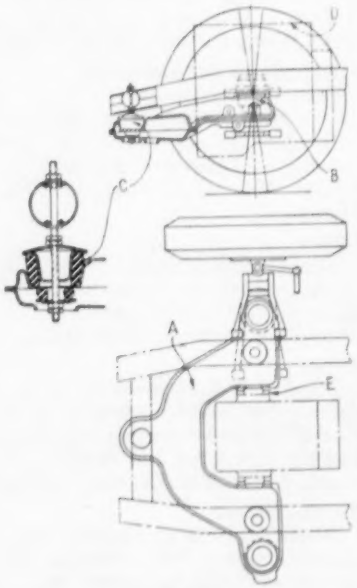
To reduce abrasion and to lower the operational temperature of metal working tools, it is customary to make use of lubricating and cooling fluids. While such methods effect a useful improvement, chip welding can frequently be avoided only by lowering the speed or feed of the tool. The object of this invention is to counteract the welding capability of the tool by the incorporation of sulphur in the constituent material. For a tool of high speed steel, for example, sulphur up to a value of 1 per cent may be included in the form of molybdenum sulphide, manganese sulphide, or lead sulphide. These materials, which are not susceptible to contact welding, may be added singly or in any desired combination.

To be effective, it is essential that the additions are uniformly distributed throughout the tool material structure. In the case of solid steel tools, the metal-sulphur compound is introduced in the chill-mould with the casting of the melt. For tool tips, the additions are included in the unsintered powder mixture. It is claimed that tools incorporating sulphur as specified have increased resistance to wear, which is apparent in capability to sustain higher cutting speeds and longer life between regrinds. These results are obtained as the additions form a very thin lubricating film during operation, which prevents contact welding of tool and work. *Patent No.* 748014. *Gebr. Bohler and Co. A.G. (Austria).*

Front suspension adjustable for castor

In this front suspension arrangement for a normal rear-drive vehicle, the wheels are independently sprung from an auxiliary framing which is adjustable on the chassis structure to modify the castor angle. The pressed sheet metal auxiliary framing A is of bowed shape in plan and is suspended below the chassis frame on three cupped rubber mountings. While the lateral mountings B are fixedly secured to the chassis side members at approximately wheel centre height, the central mounting C is vertically adjustable from a forward cross member.

Wheels are carried on upper and lower wishbone levers mounted on the auxiliary framing and move in a substantially vertical plane which contains, or is closely adjacent to, the aligned centres of mountings B. The forward end of power unit D is supported from framing A by rubber mountings E, also in approximate alignment with mountings B, while the rear of the unit is resiliently supported from the chassis frame. Thus, by adjustment of mounting C, the framing A can be swung about the mountings B to set or adjust the castor angle of the wheels. The relative heights of wheels, chassis frame, and power unit will be unaffected, or, at most, only to an insignificant extent. *Patent No.* 748466. *Daimler-Benz A. G. (Germany).*



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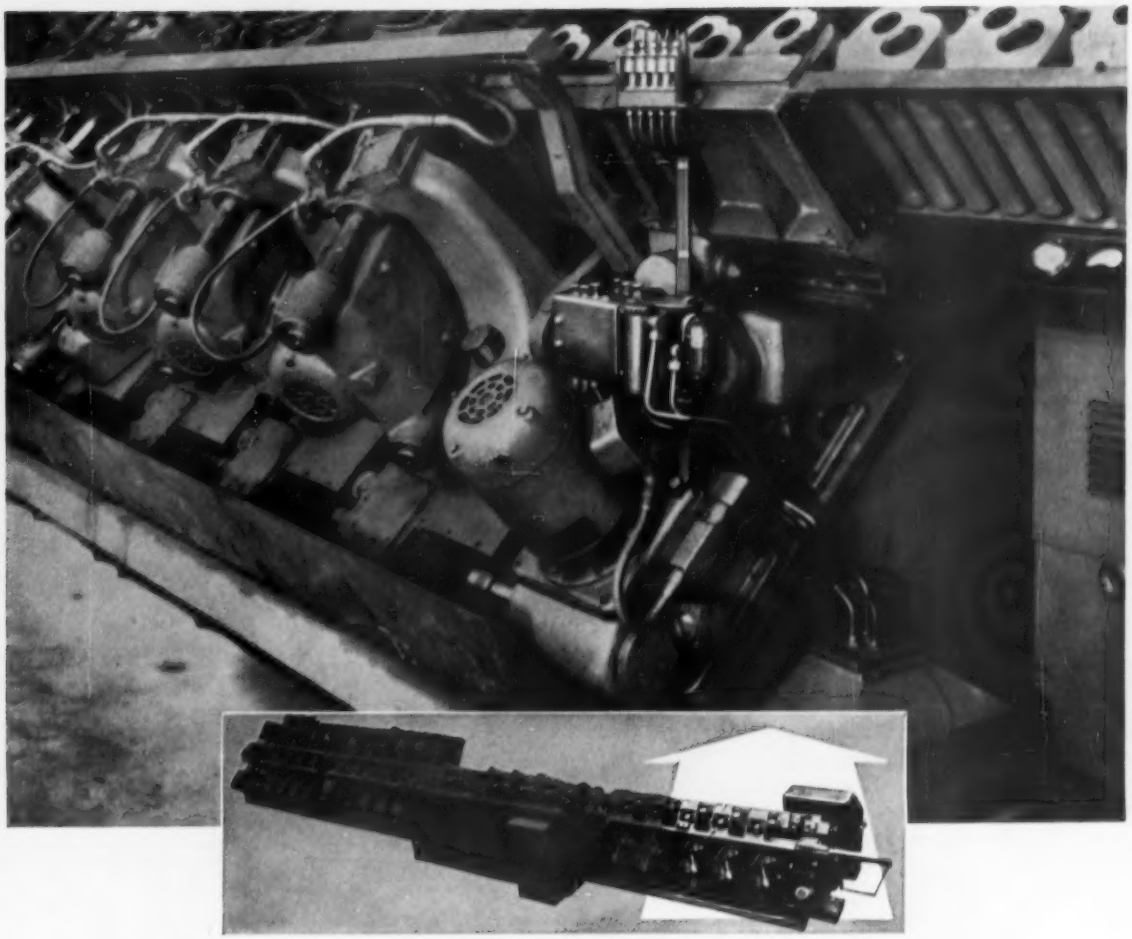
Hydraulic Transmissions

The conclusion of the article "Hydraulic Transmissions" by R. Dean-Averns, Part I of which appeared in the October issue, will be published in the December issue.



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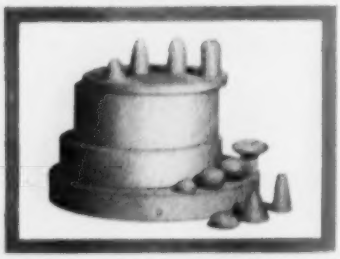

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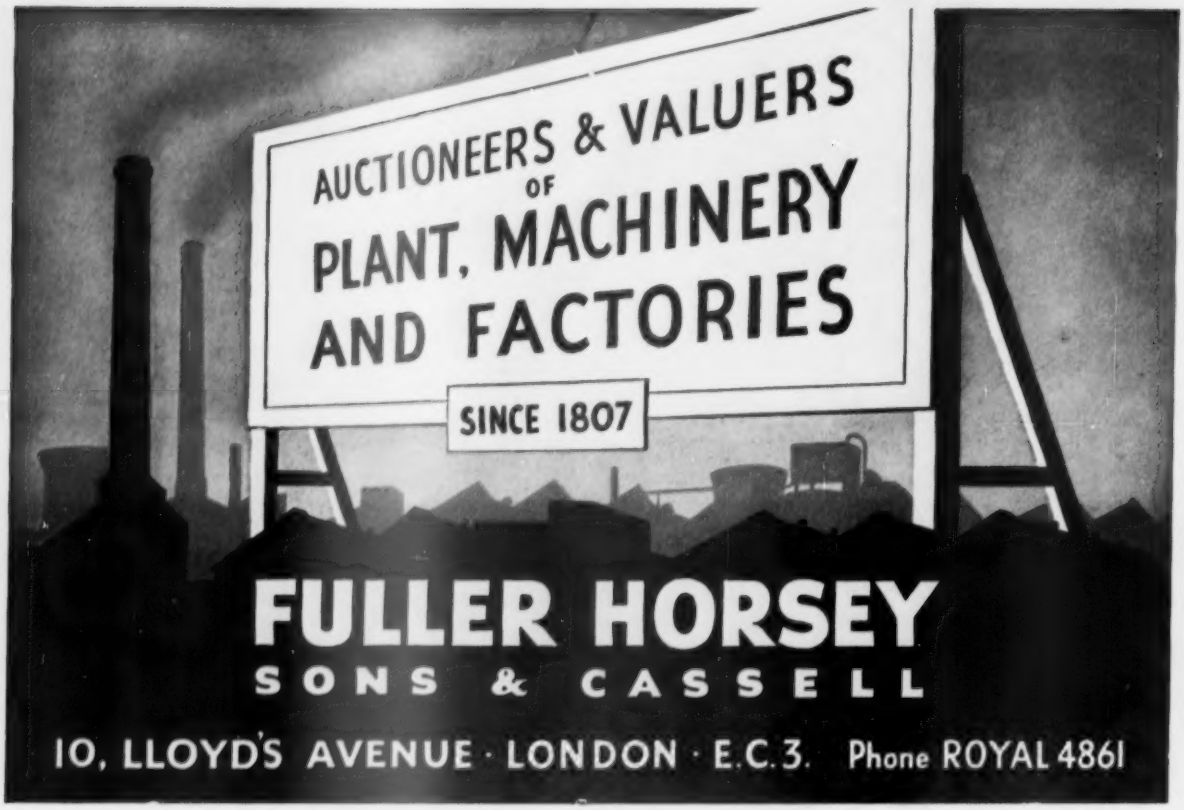

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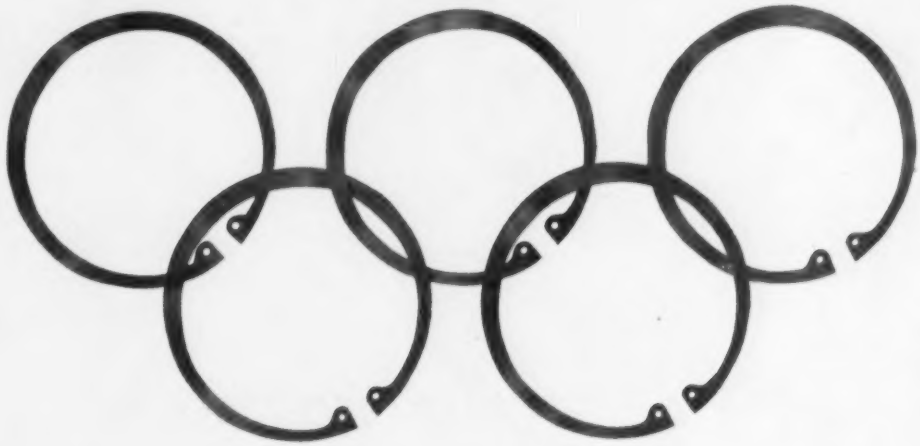

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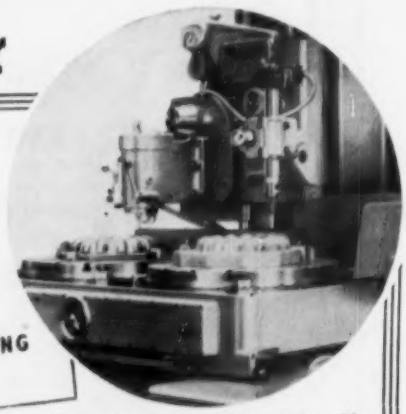

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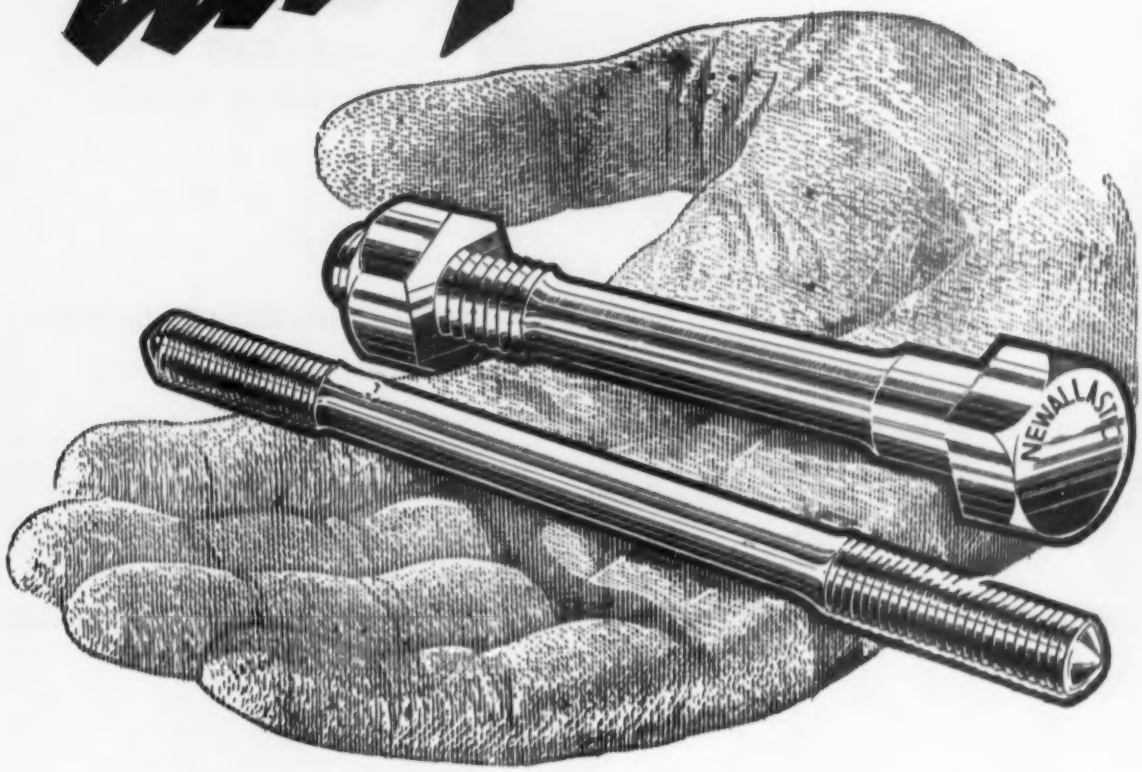

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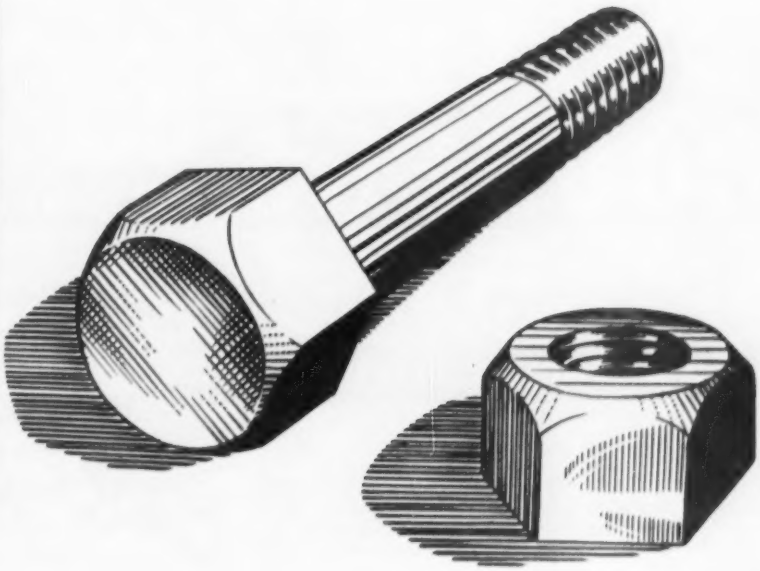

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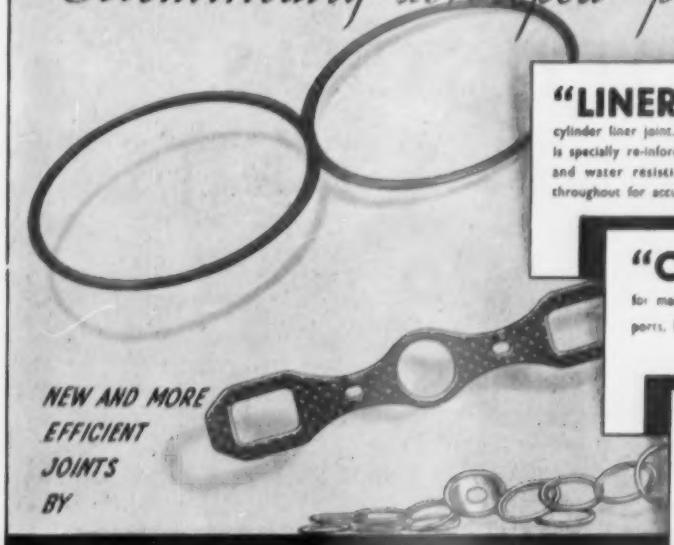

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When the Romans invaded Britain they were faced with the problem of creating suitable highways which would give their legions access to the ends of the country. Of the many they built the most important and famous were the Four Ways; Watling Street, The Fosse, Ermine Street, and Icknield Street.

Ermine Street, the third of the Four Ways, was a direct road from London to Lincoln and on to Wintringham on the Humber. By means of a ferry it made communication with Brough and York. North of Lincoln another road diverged from it Westwards to Doncaster. Near London the Enfield Highway is part of the old road.

In Lincolnshire, Ermine Street is known as a 'ramper' or 'The Old Street.' Like Watling Street and the Fosse Way, Ermine Street appears to have been paved from end to end.

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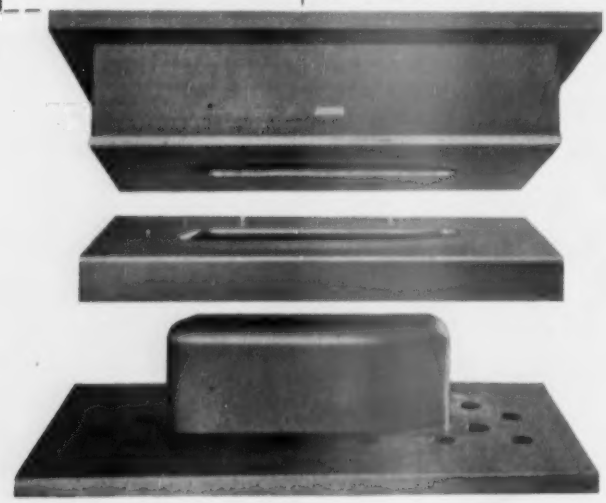

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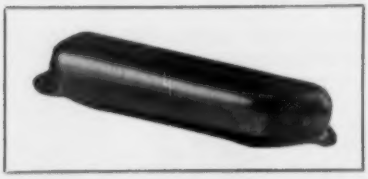

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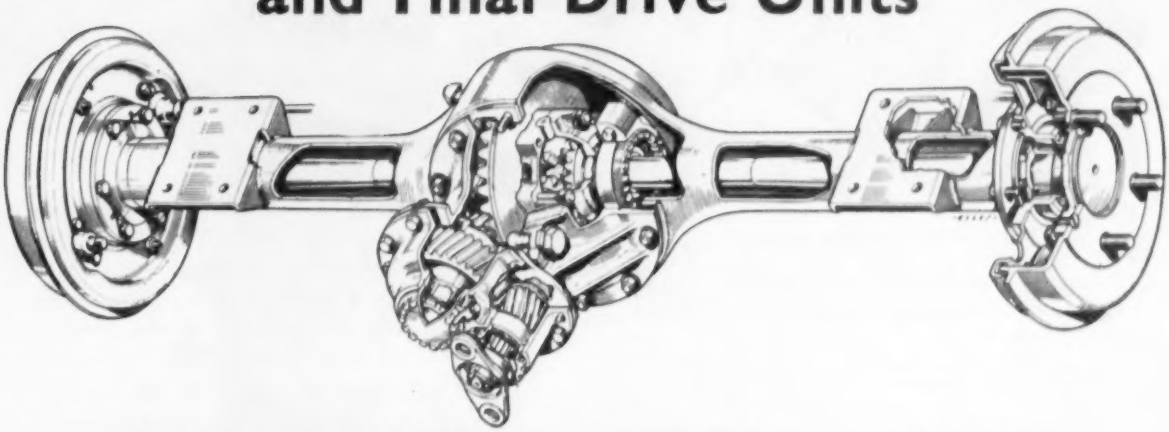

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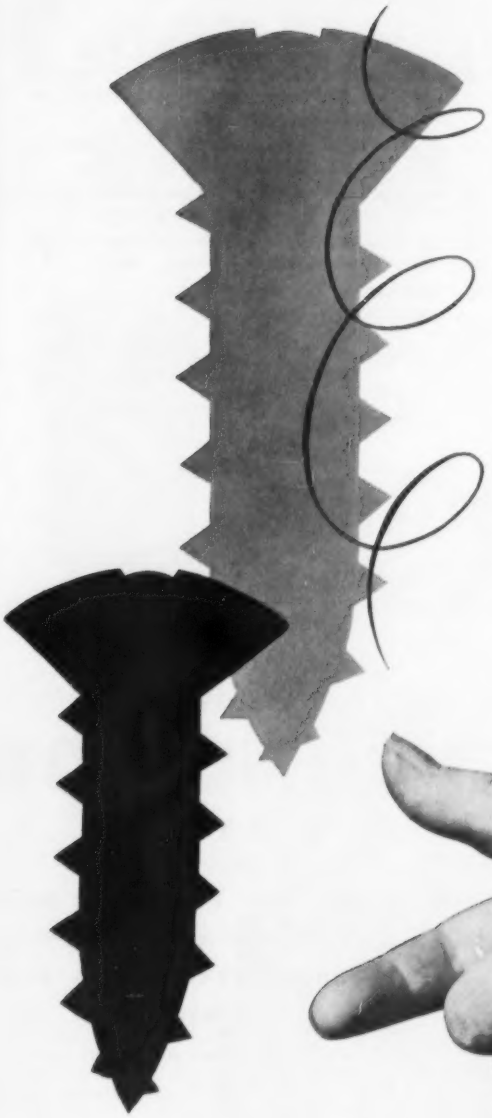

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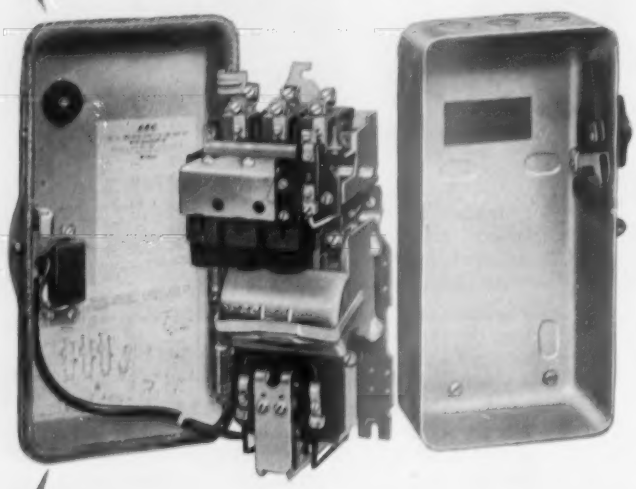

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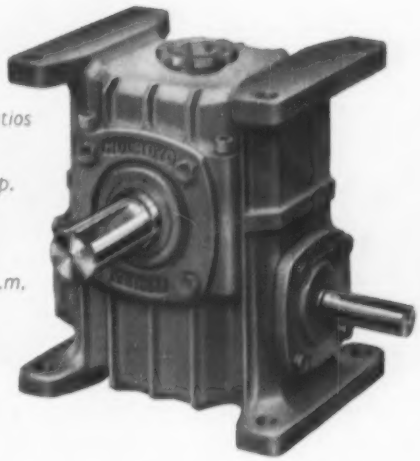

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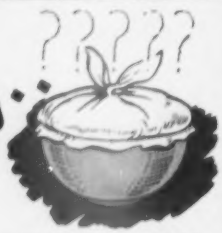

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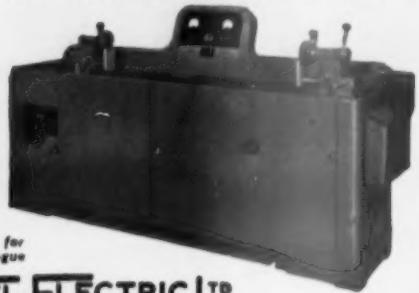

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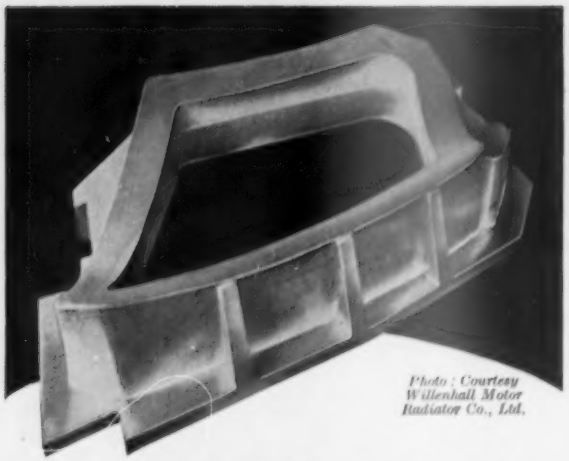

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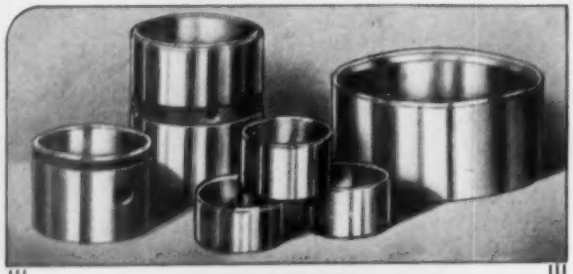

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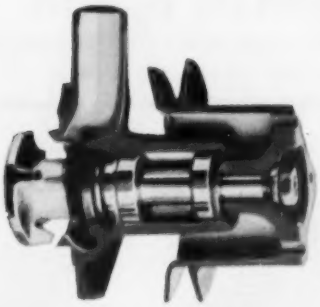

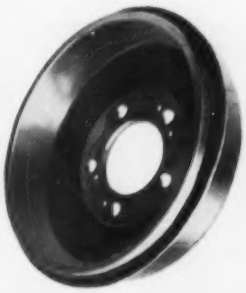

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Daniel WEBSTER (1782-1852)

SEA

"The most advanced nations are always those who navigate the most."

Ralph Waldo EMERSON (1803-1882)

& AIR

"Soon shall thy arm, unconquered steam, afar
Drag the slow barge, or drive the rapid car;
Or on wide waving wings expanded bear
The flying chariot through the field of air."

Erasmus DARWIN (1731-1802)

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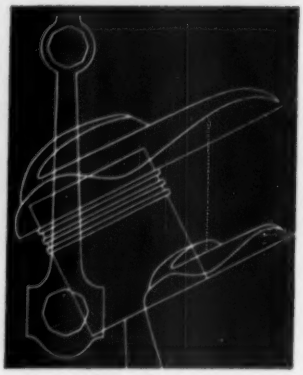

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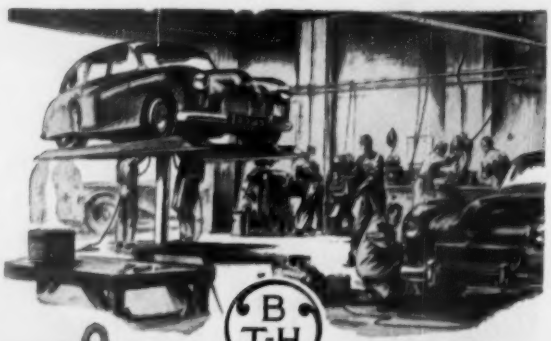

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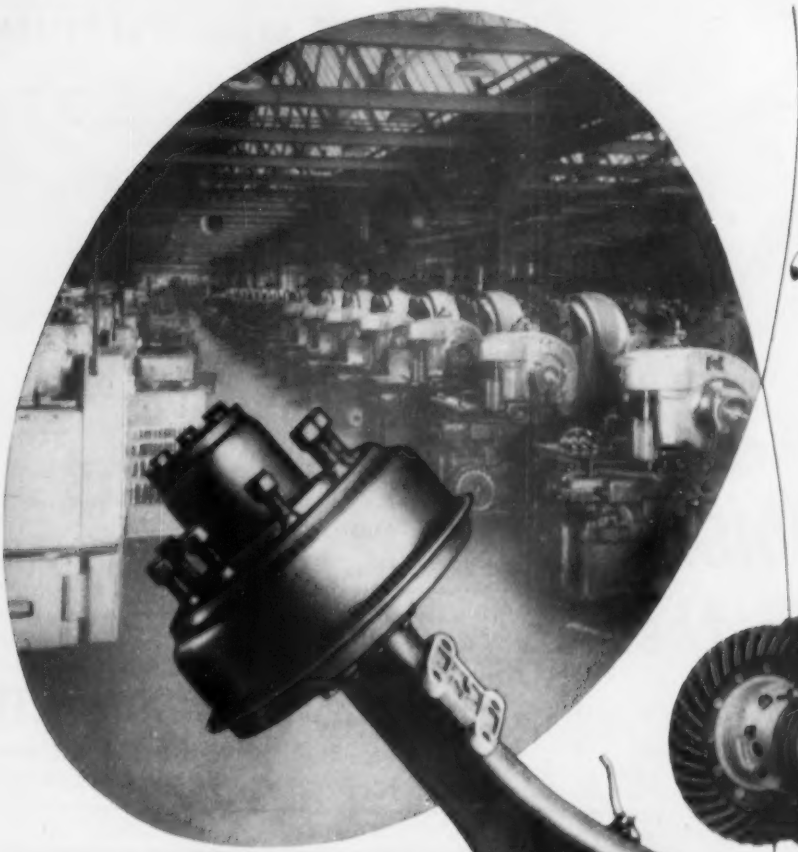

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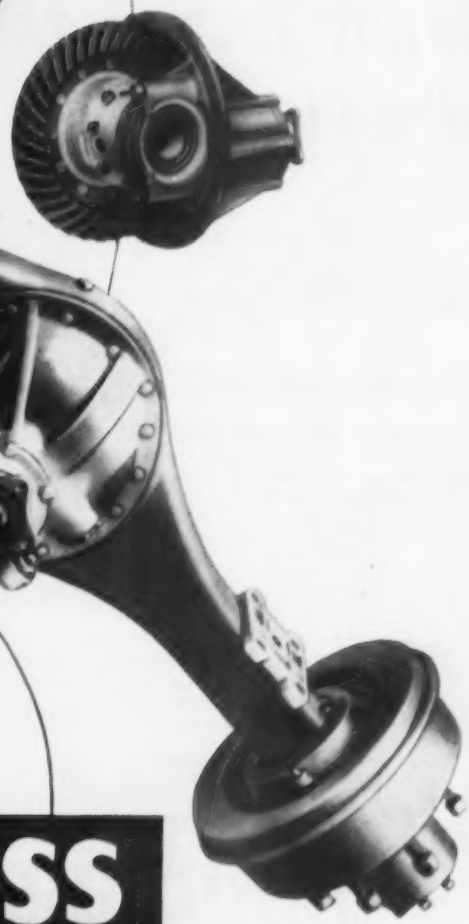

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A finer, more compact lead structure results, because millions more minute graphite particles are compressed into every inch of lead.

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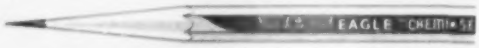

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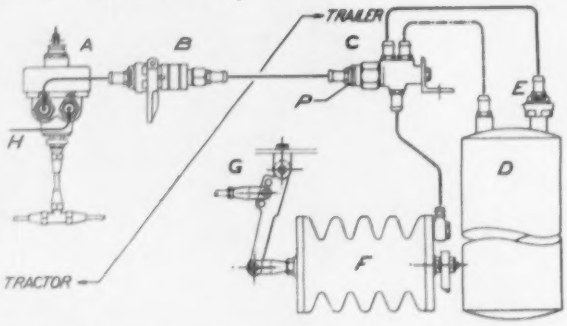

A. Hydraulic Reaction Valve LV 207 Dual Control, shown fitted to Hydraulic Pipe Line on Tractor.

B. "C" type Coupling with Auto. Shut-off Valve, attached to rear of Tractor.

C. Breakaway Valve SBS. 256 (or SBS. 257) attached to Tow Bar of Trailer.

D. Vacuum Tank on Trailer.

E. Non-return Valve.

F. Power Unit on Trailer operating linkage "G" to Trailer Brakes.

H. Hose connecting LV 207 to source of Vacuum Hose connections shown as solid lines are those used in normal operation of Brakes.
The Hose shown in broken line connects the Vacuum Tank to the Power Unit when Valve "C" is operated in emergency.

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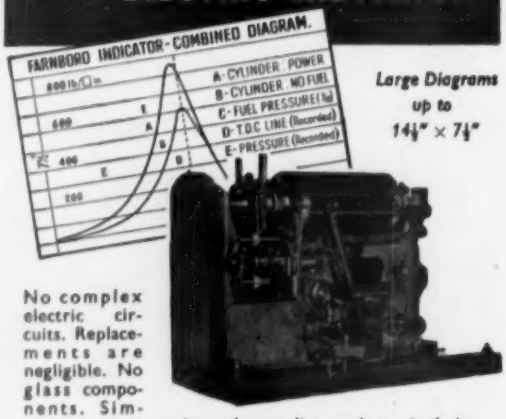

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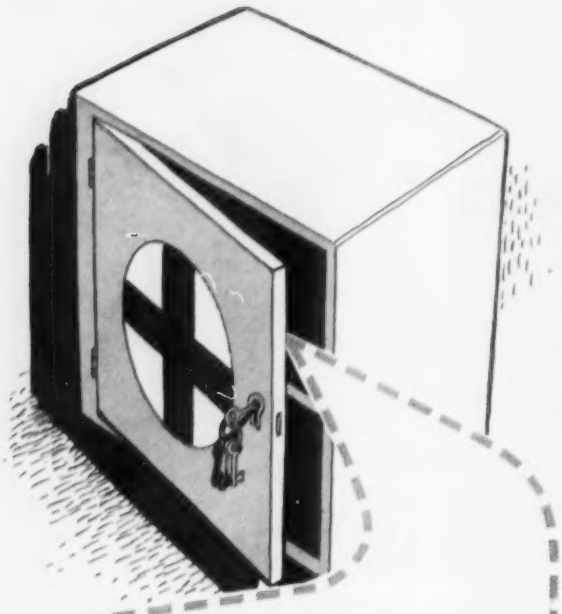

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The Udal 'Fastrip' guard is safe because it is not frustrating. Guard and clutch are synchronised to ensure split-second timing, allowing the highest standard of safety without impeding production. So the operator is not tempted to sacrifice safety for speed. Send for details today.

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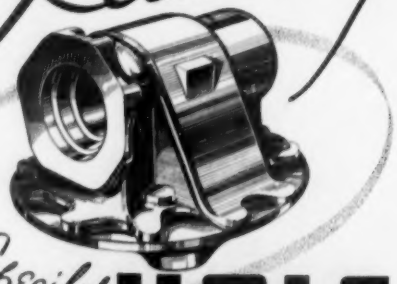

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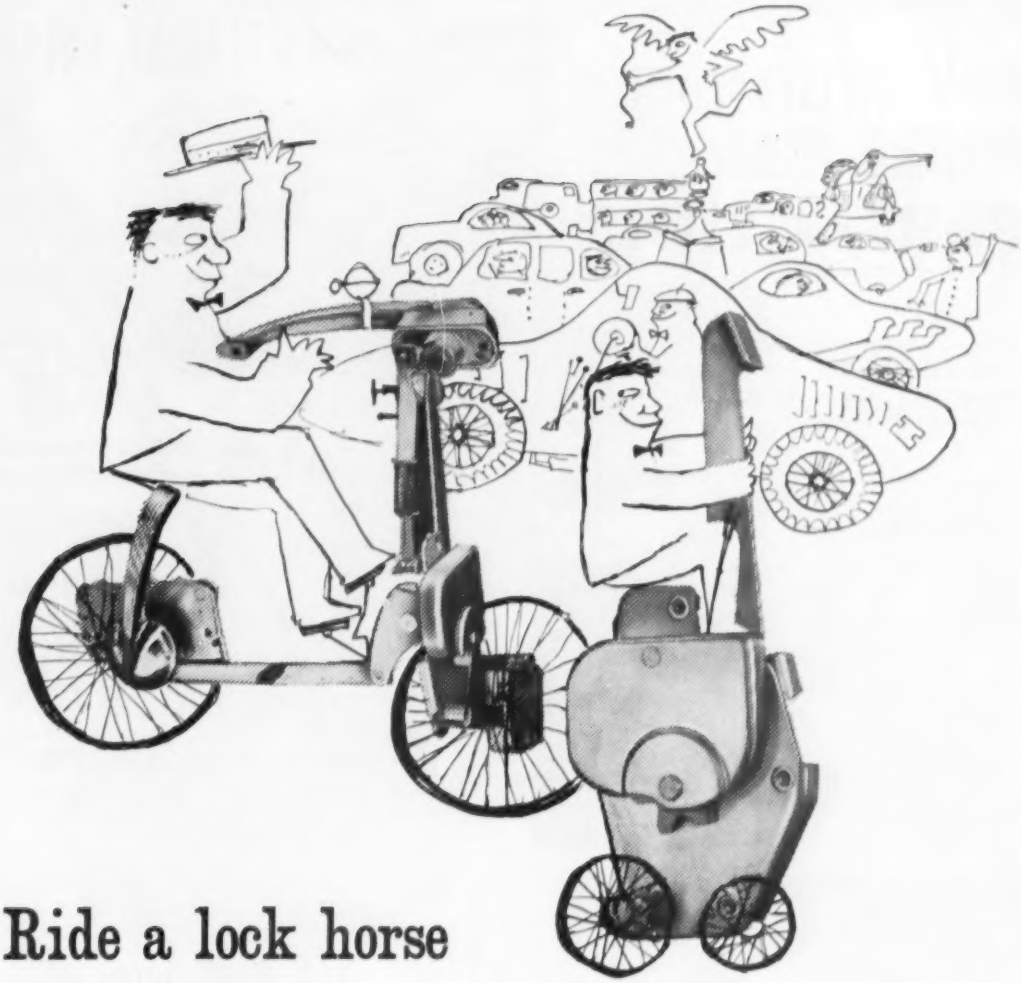

Ride a lock horse

That Wilmot Breeden provide motorists with keys is well known. We can't leave it at that. What about locks?

Now, locks are important. Not more important than the cars they belong to (as our picture might suggest), but components carrying so much individual responsibility that a good car with inefficient locks is a contradiction in terms.

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Add this particular skill and study to the production of bumpers by the hundred thousand, radiator grilles, steering wheels, handles, window regulators . . . and you arrive at a large, interesting fact . . .

virtually every British car on the roads today owes some part to Wilmot Breeden.

WILMOT BREEDEN ARE AT BIRMINGHAM:
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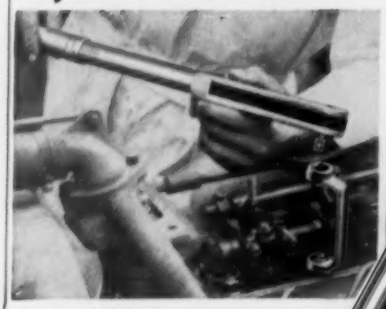

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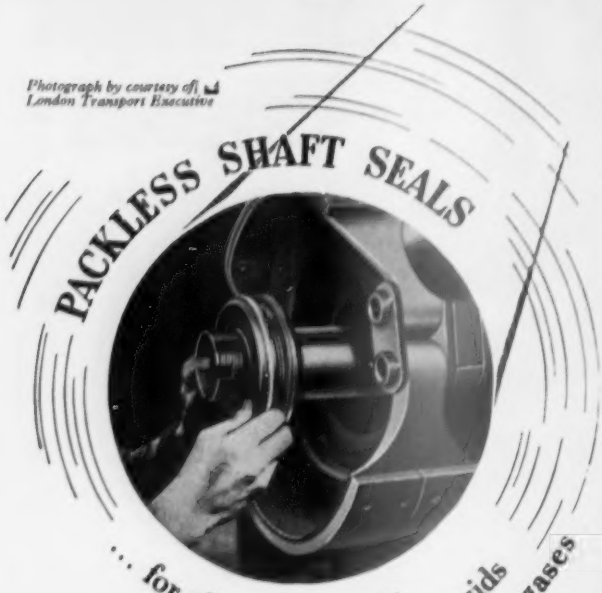
Teddington

Photograph by courtesy of the London Transport Executive



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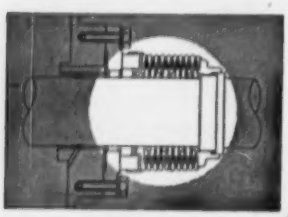
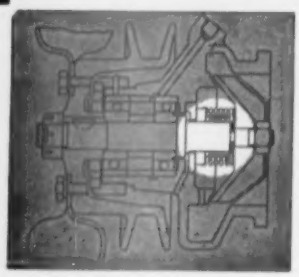


The British Thermostat Company are the largest manufacturers of metallic bellows in Europe and, during the last 25 years, have acquired unique experience in the design and application of metallic bellows and packless shaft seals. Write for leaflet NS. 5.



Expansion of business and the desirability of providing a specialised unit for the manufacture of shaft seals and bellows has led the British Thermostat Co. Ltd. to expand one of its subsidiaries to handle these products from September 1st. Future orders and enquiries should therefore be addressed to:

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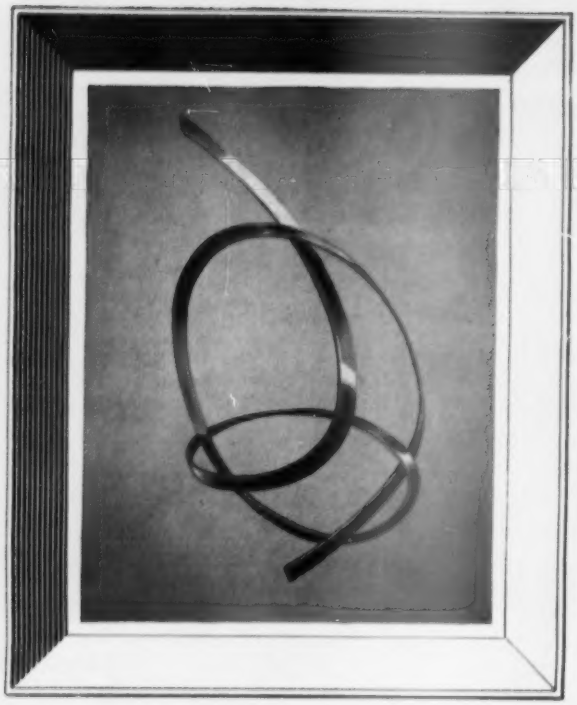

Portrait of a Piston Ring

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IF THAT SOUNDS INTERESTING to you, why not get into touch with us? We will tell you all you want to know about Cords, and gladly provide a set, to your requirements, for you to test in your own way.

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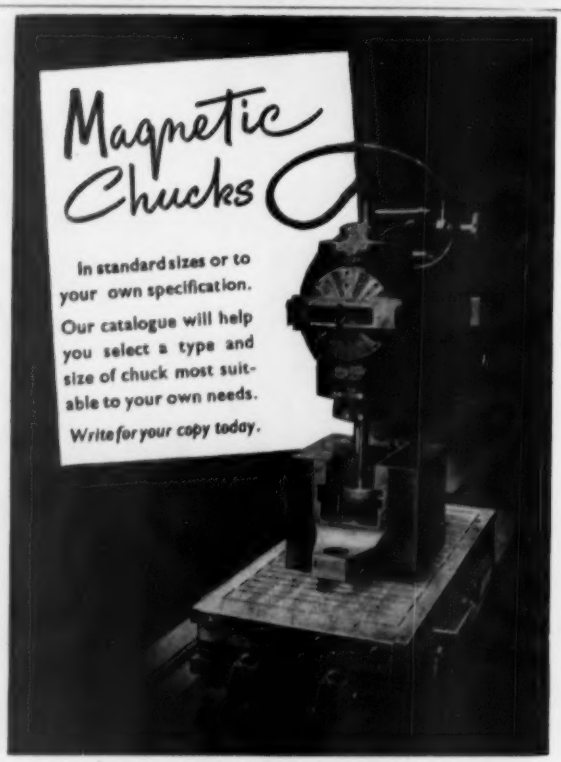
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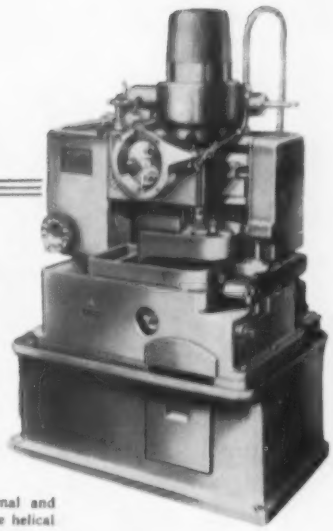

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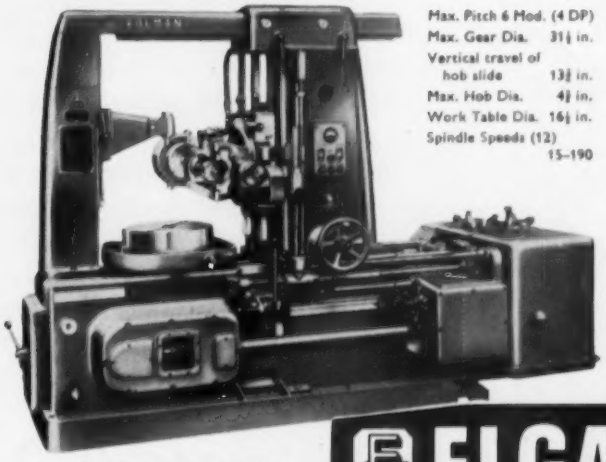

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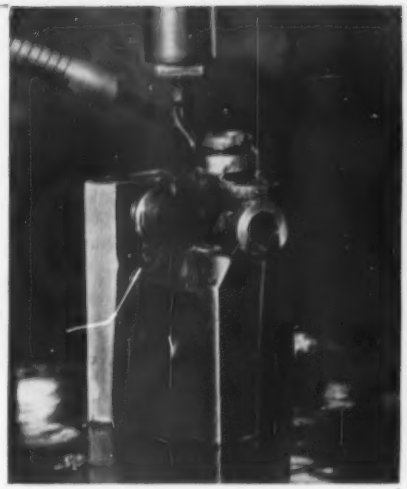

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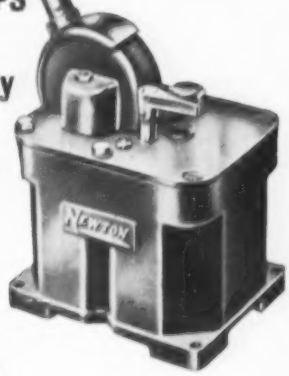

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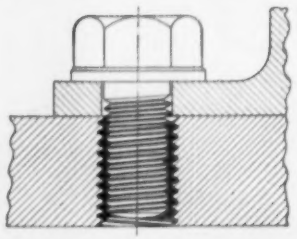

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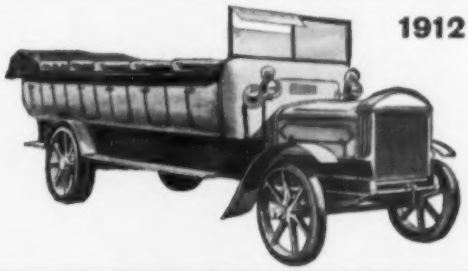

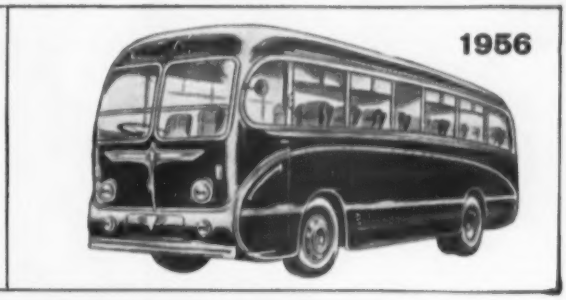

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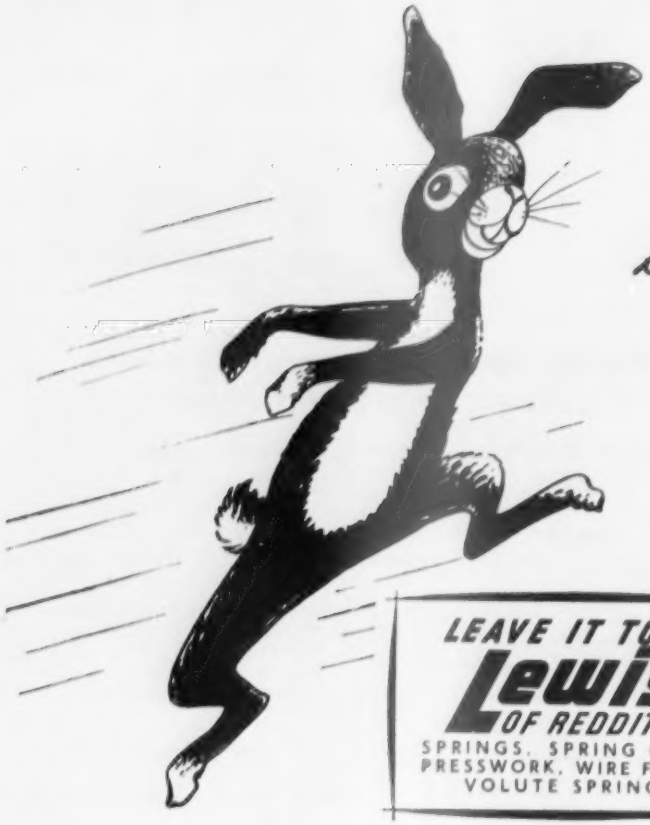

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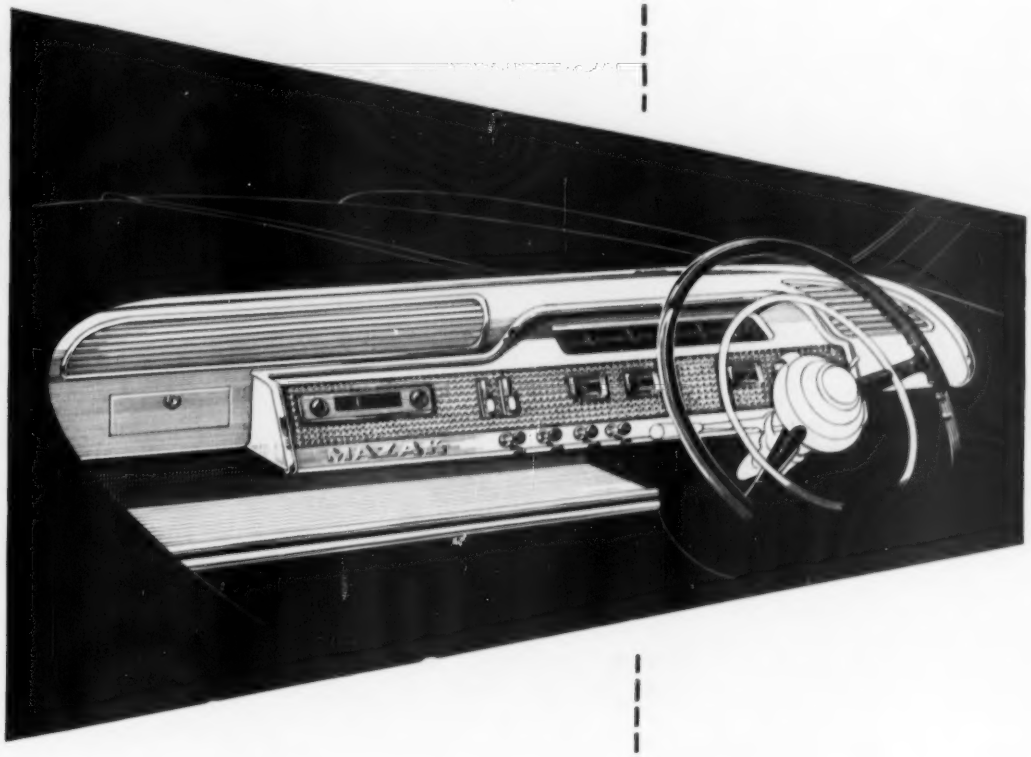

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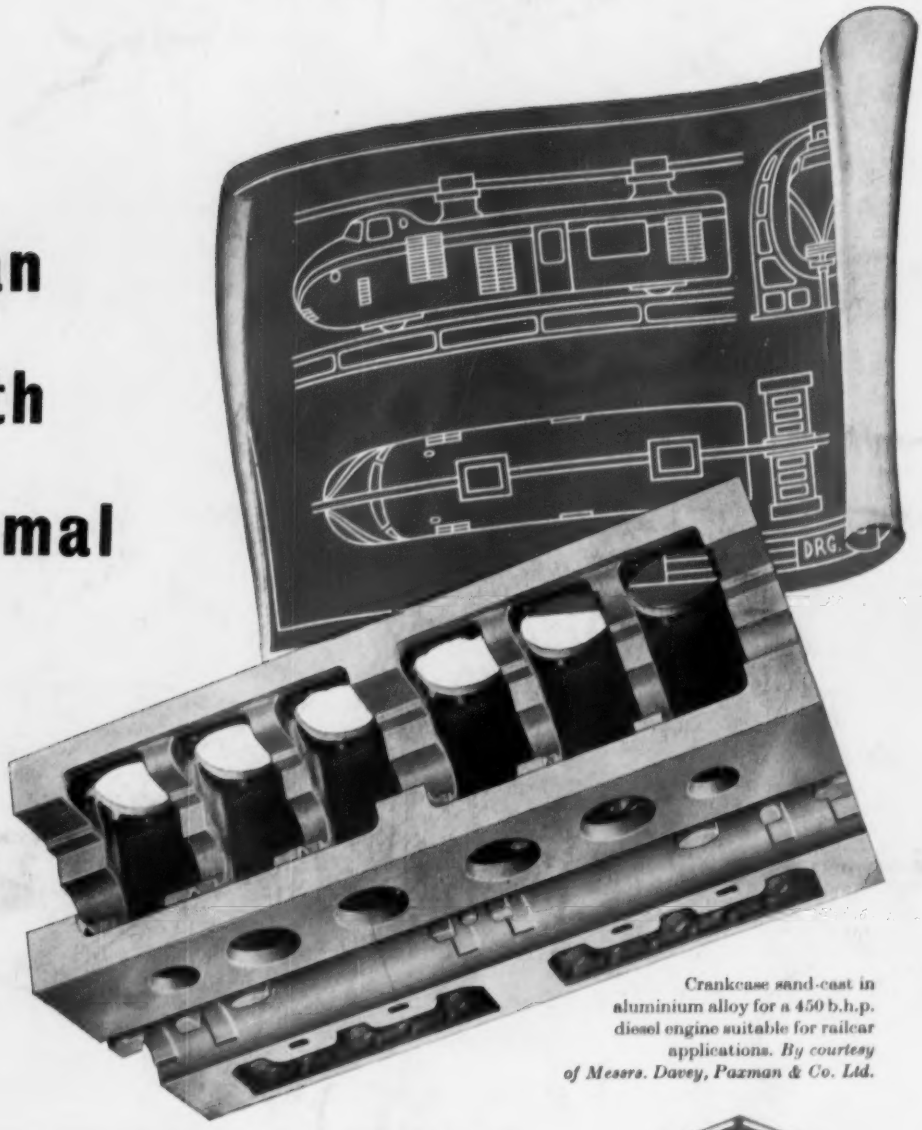

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